

AMERICAN JOURNAL OF OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

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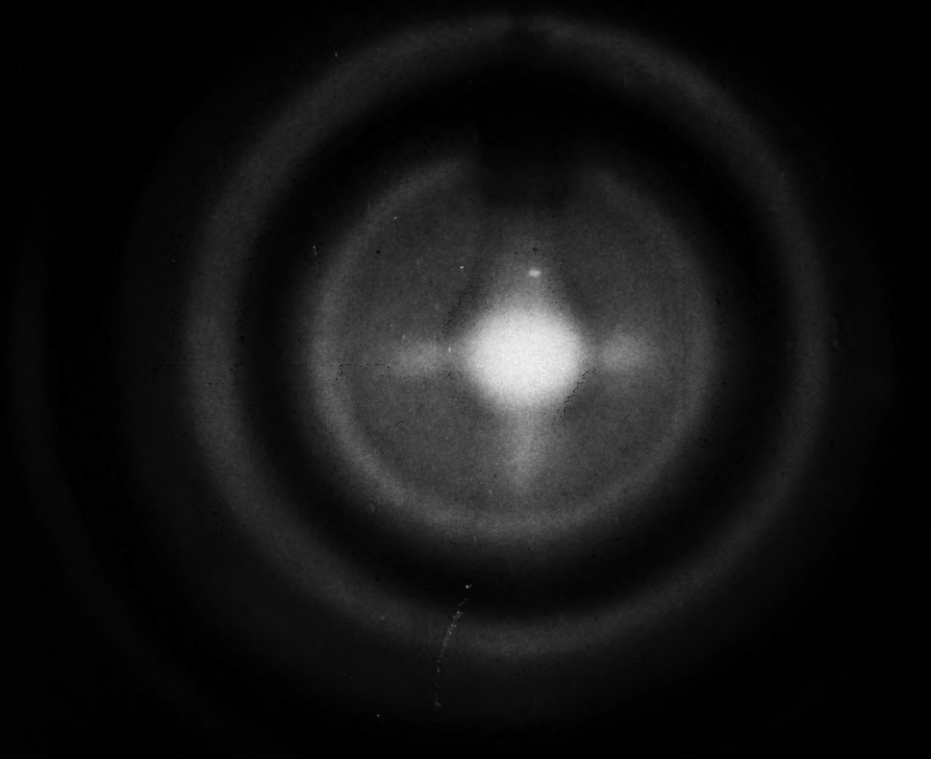
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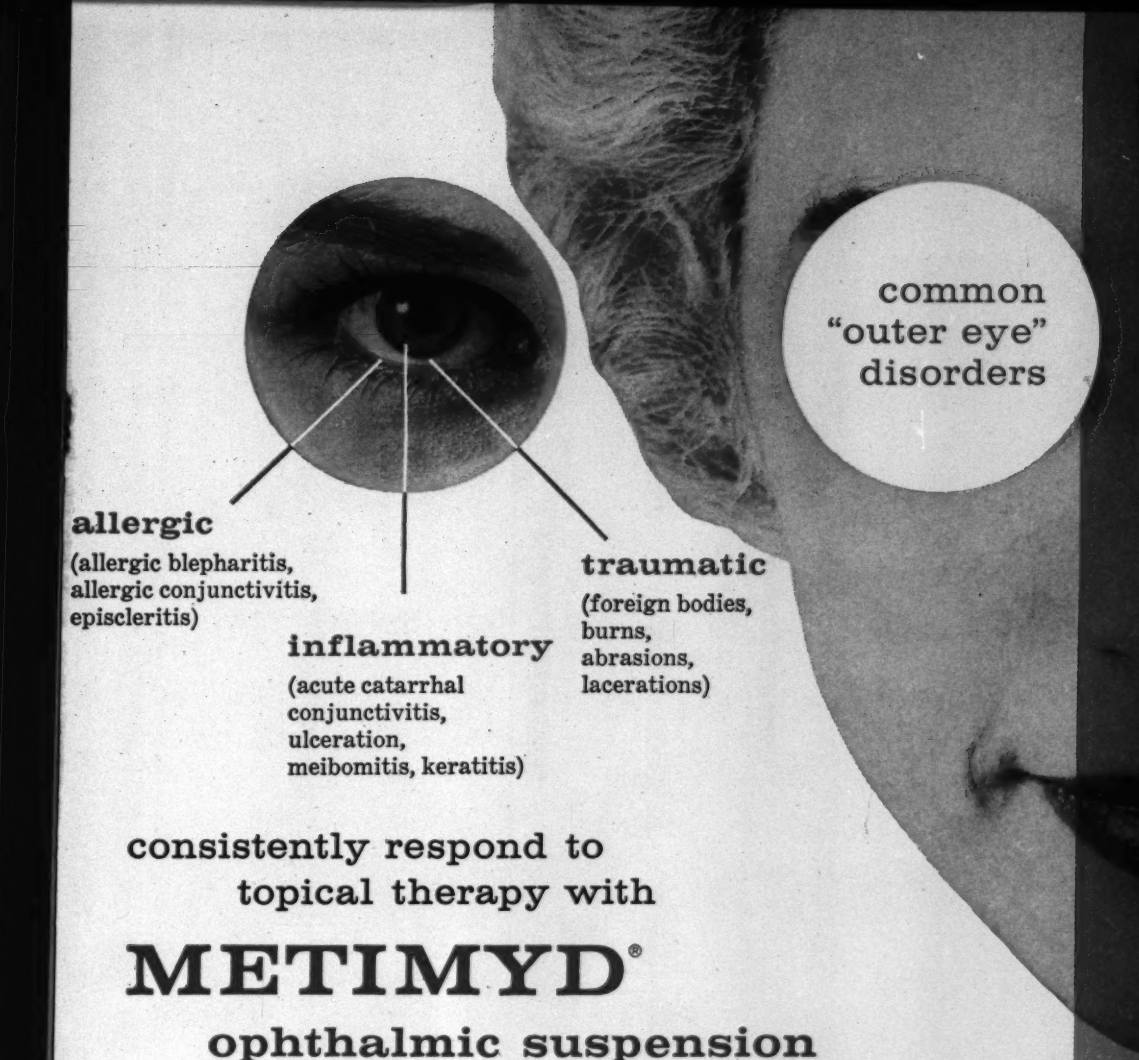
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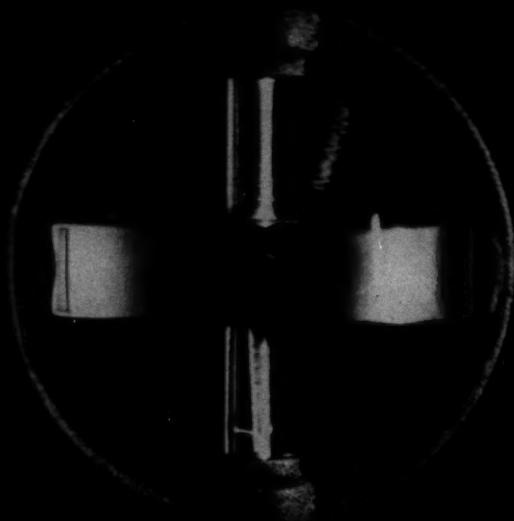
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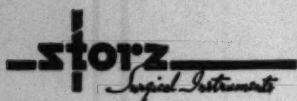
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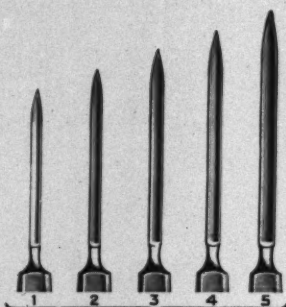


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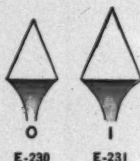
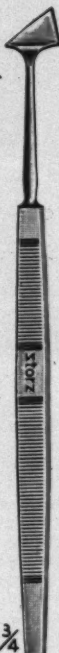
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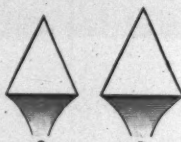
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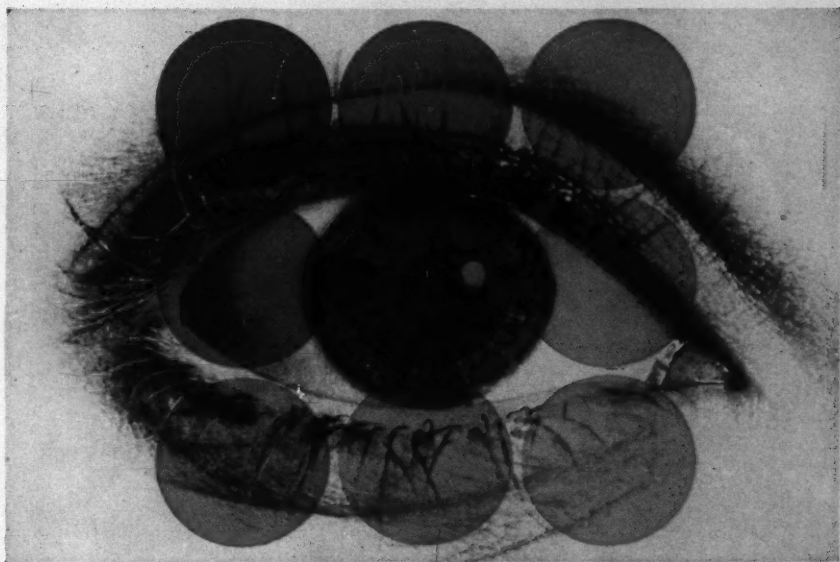
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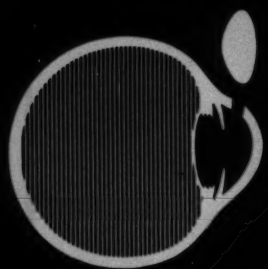
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1. New and Nonofficial Drugs; J. B. Lippincott Company, Philadelphia, 1958, p. 243.

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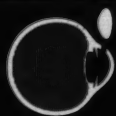
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¹Girard, Louis J., and Neely, Wanda: "The Evaluation of Zolyse in Cataract Extraction", Research Report No. 11, Alcon Laboratories, Inc., 1959.

²Boyd, Benjamin F.: Enzymatic Zonulysis, Highlights of Ophth., vol. III, no. 4, pg. 70, 1959.

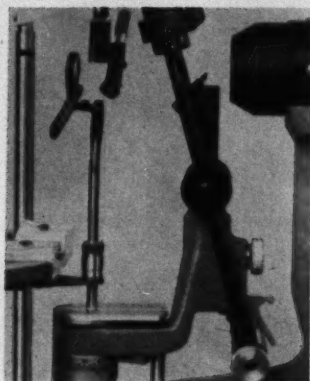
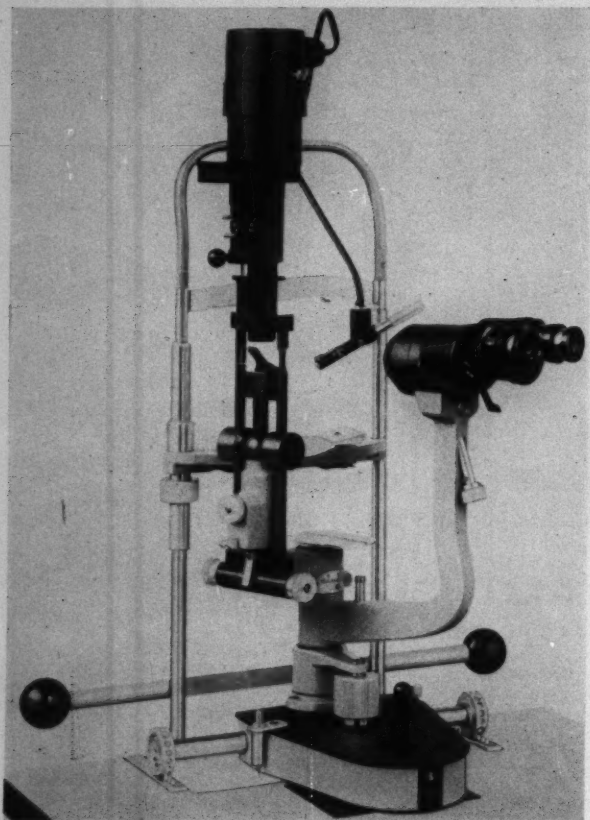


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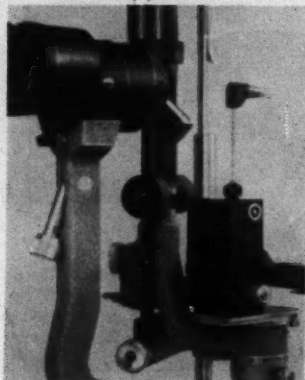
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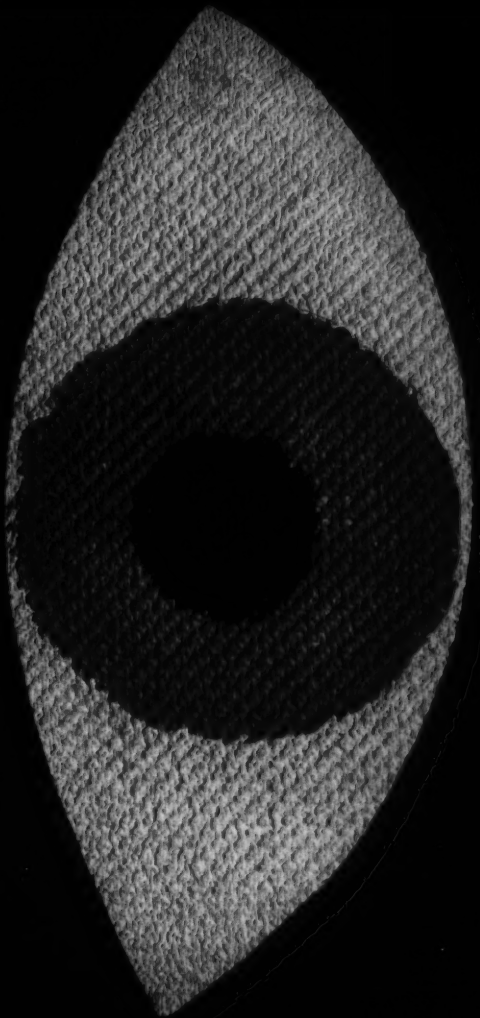
References: (1) Perkins, E. S.: *Practitioner* 178:575, 1957. (2) *Queries and Minor Notes, J.A.M.A.* 161:1032, 1956. (3) Smith, C. H.: *Eye, Ear, Nose & Throat Month.* 34:580, 1955. (4) *Blakiston's New Gould Medical Dictionary*, ed. 2, New York, McGraw-Hill Book Company, Inc., 1956, p. 945. (5) Ostler, H. B., & Braley, A. E.: *J. Iowa M. Soc.* 44:427, 1954.



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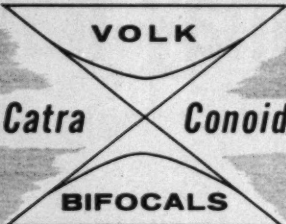


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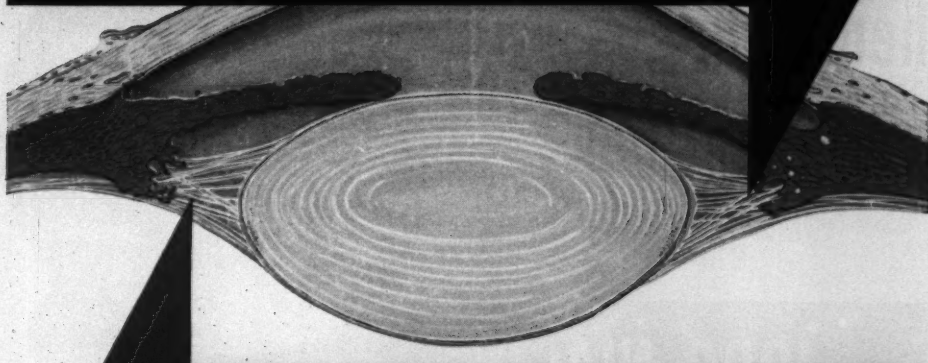
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1. Raiford, M. D.: J. M. A. Georgia 48:163, 1959. 2. Rizzuti, A. B.: A. M. A. Arch. Ophth. 61:135, 1959. 3. Cogan, J.E.H.: Proc. Roy. Soc. Med. 51:927, 1958.



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(Figure 2)
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1. *Am. J. Ophth.* 42:771, 1956.
2. *Am. J. Digest Dis.* 22:5, 1955.
3. *Med. Times* 84:741, 1956.

* U.S. Patent Pending

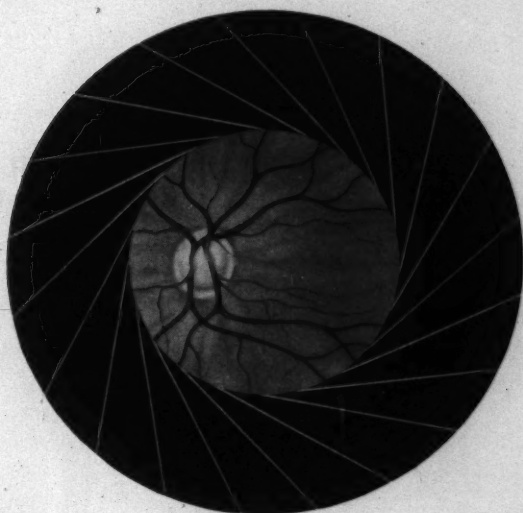
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¹ Friedman, B. S.; Medina, M. M., and Phillips, C. C. To be published. ² Ahlquist, E. P. in Drill, V. A., Pharmacology in Medicine, McGraw-Hill Book Company, Inc. New York, 1954, p. 18-24.



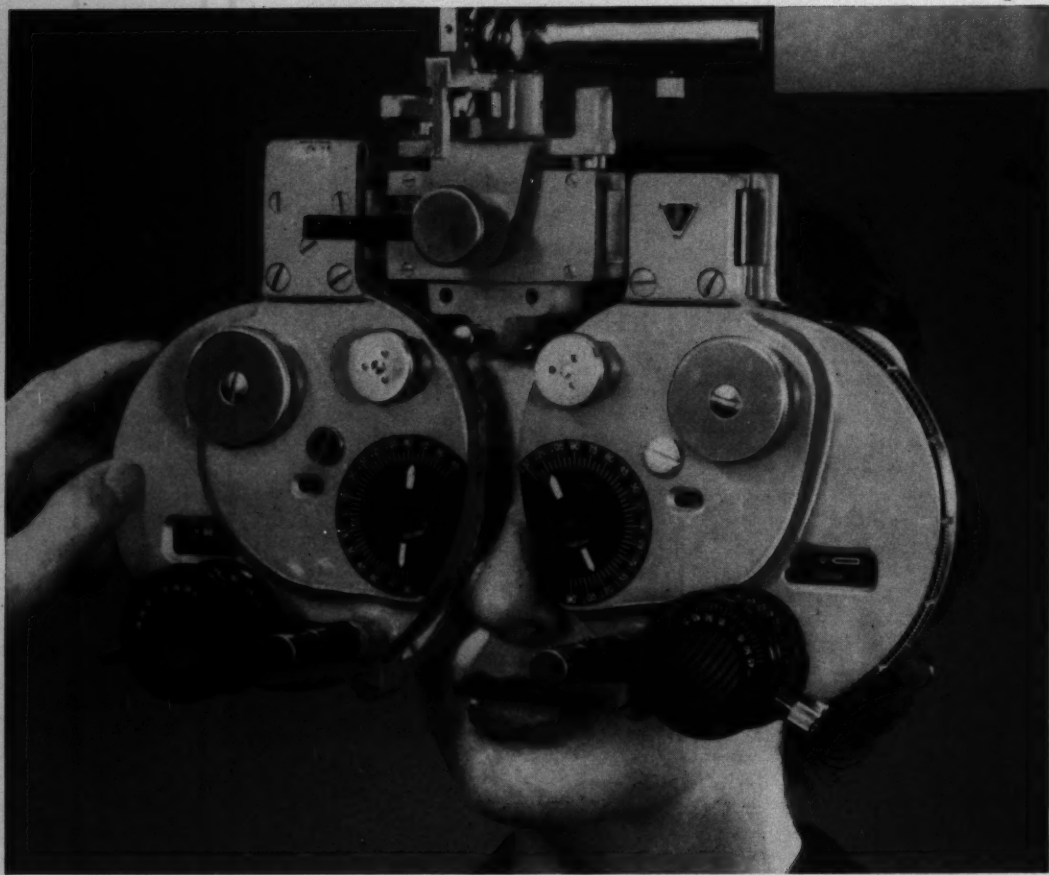
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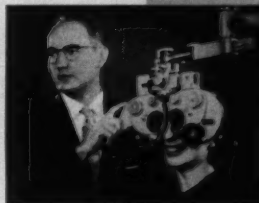
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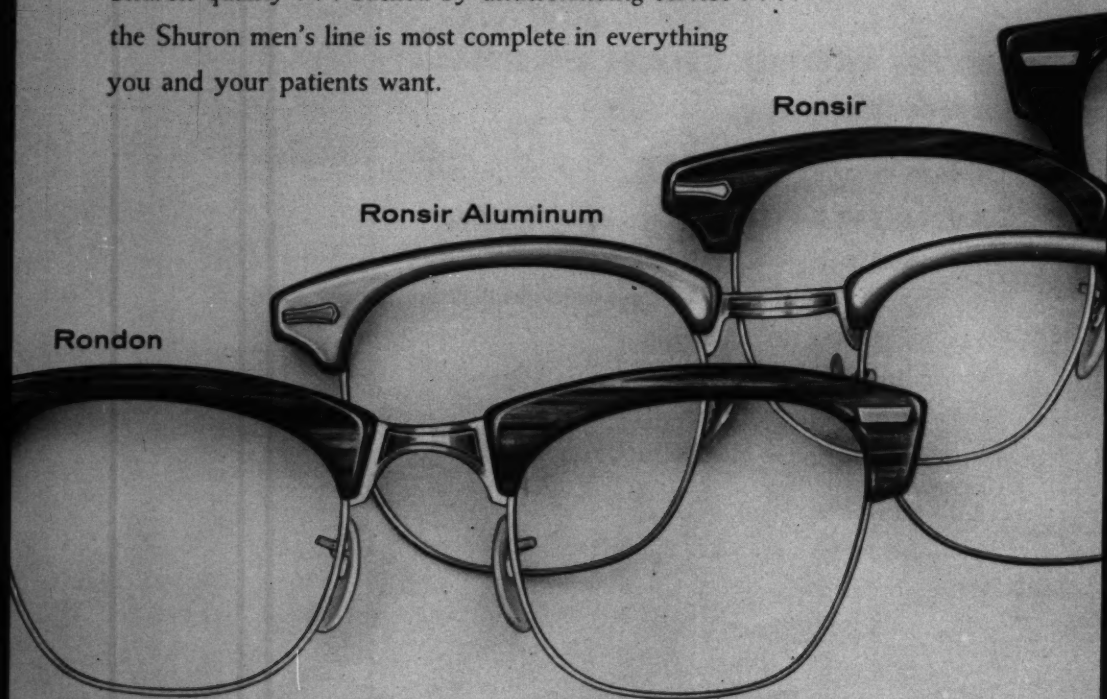
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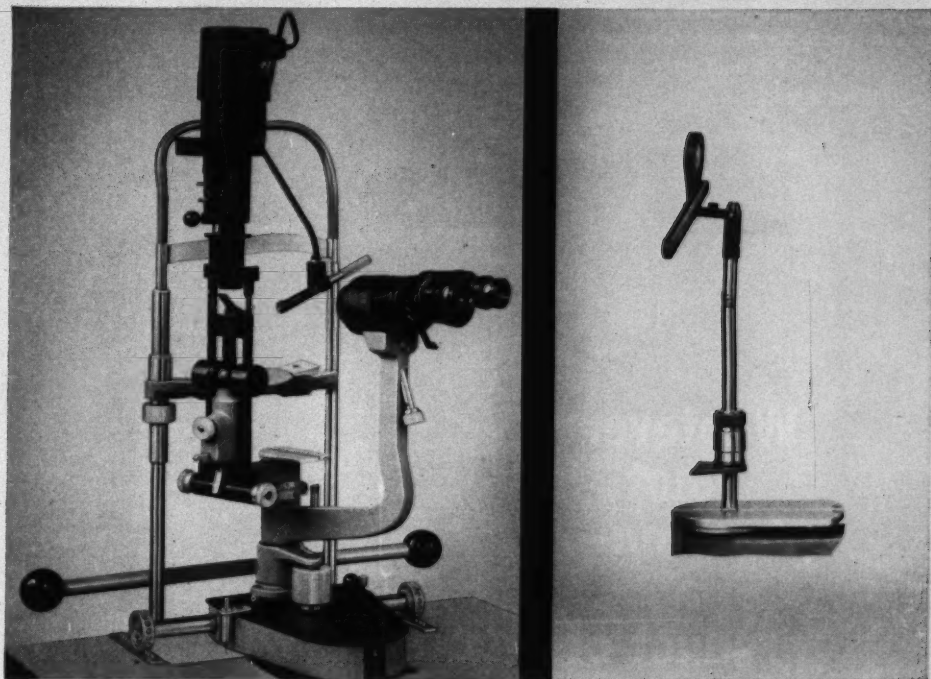
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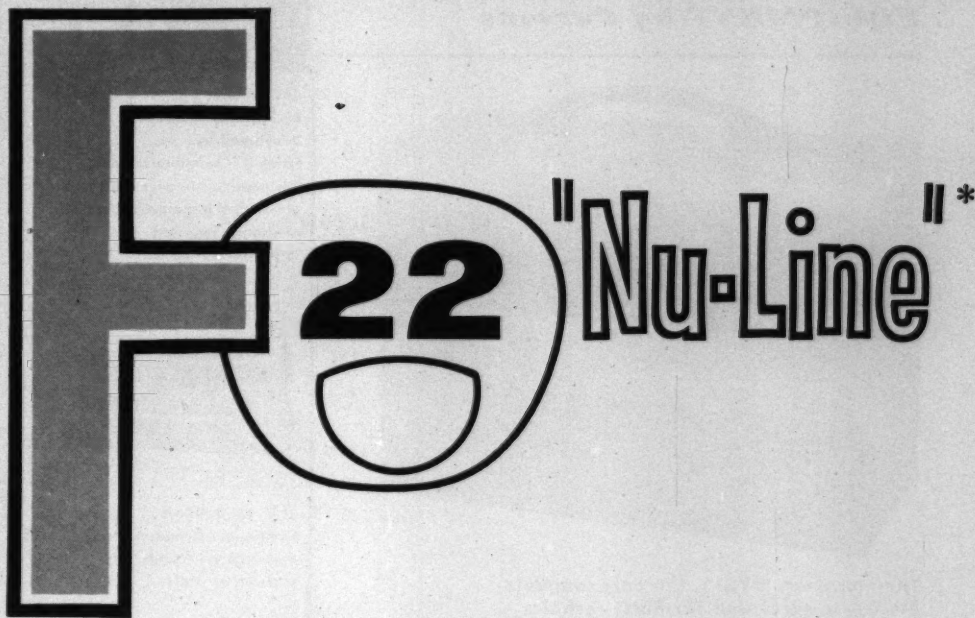
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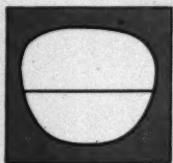


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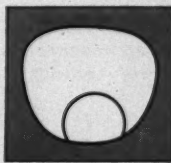
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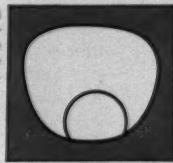


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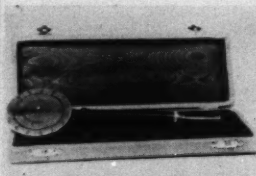
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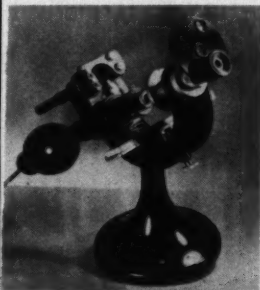
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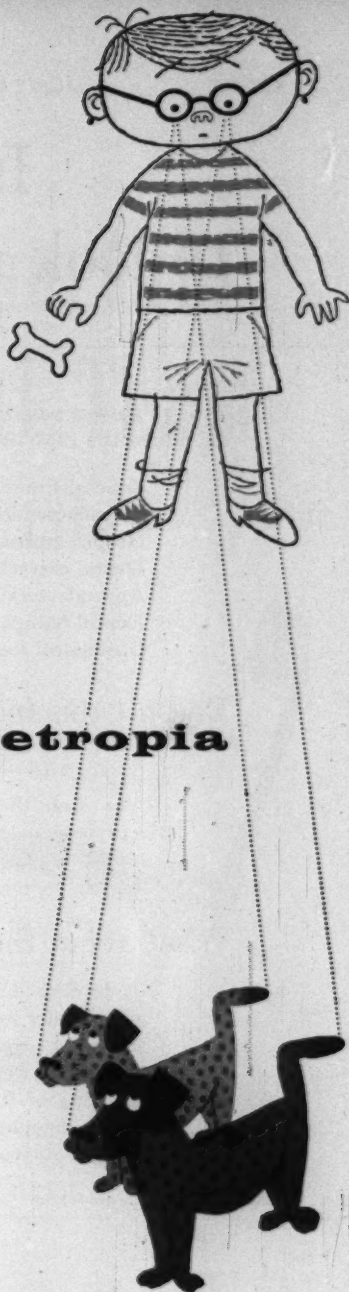
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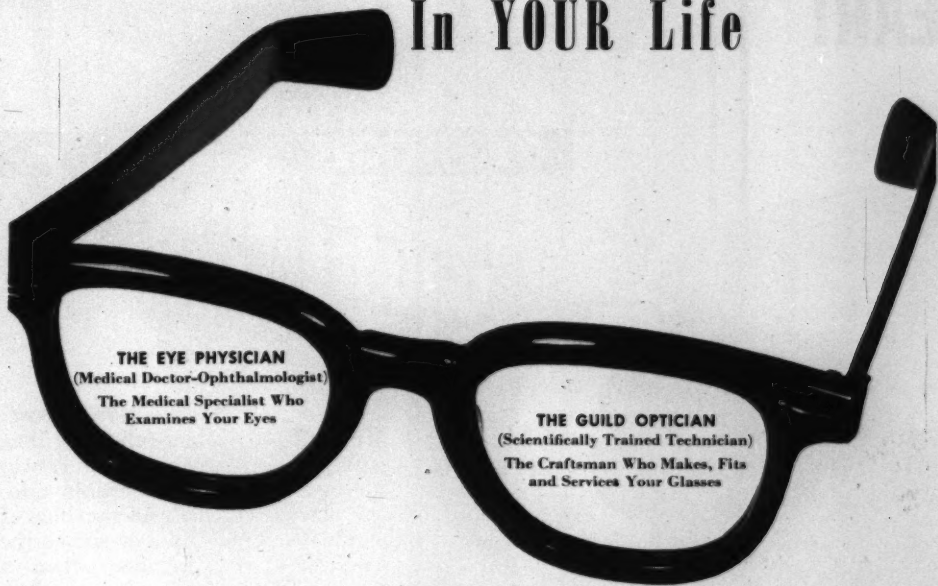
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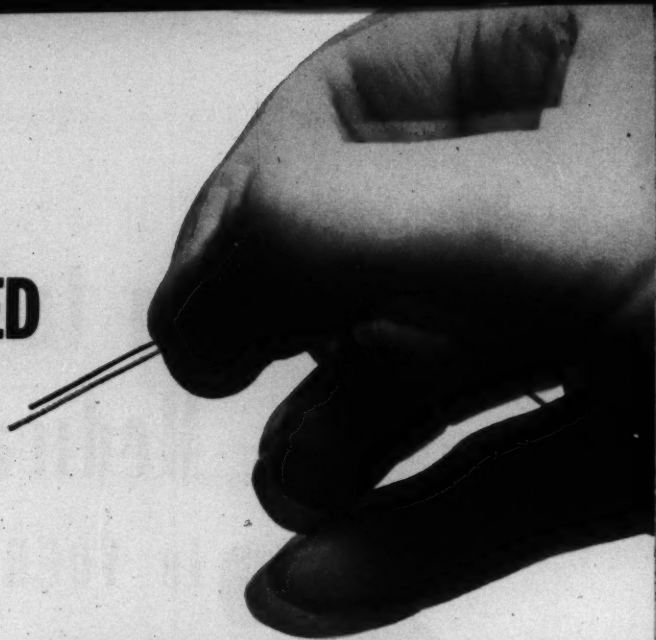
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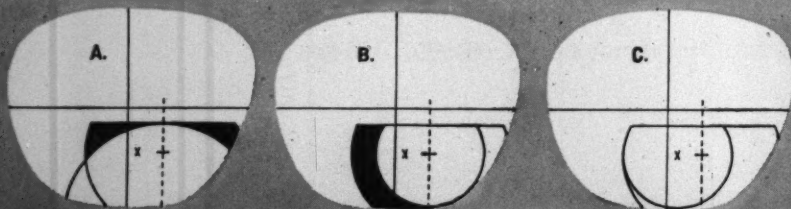
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EXOGENOUS INTRAOCULAR FUNGUS INFECTIONS*

WITH PARTICULAR REFERENCE TO COMPLICATIONS OF INTRAOCULAR SURGERY

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Fungus infections of the cornea have recently been observed and reported with increasing frequency.¹⁻³ Most of these infections have developed as complications of superficial corneal injuries or of other pre-existing corneal disease in patients who had been treated with antibiotic and corticosteroid preparations. Less attention has been given to a parallel increase in the number of intraocular infections caused by fungi. Such infections may arise in one of three ways: (a) a mycotic ulcer of the cornea may extend into the eye, giving rise to a purulent iridocyclitis with hypopyon; (b) a mycotic infection in a distant tissue may spread hematogenously to the eye, producing a diffuse retinitis and a deep vitreous abscess; (c) a surgical or accidental penetration of the globe may carry fungal elements into the ocular tissues.

It is to the third of these pathogenetic mechanisms that we wish to direct attention in this paper, for we suspect that such cases are now occurring more frequently than is generally realized. Cases of mycotic endophthalmitis have been recognized for many years, but in the past most of these were apparently endogenous infections. Rychener,⁴ who reviewed the literature in 1933, collected 19 cases of which only six followed penetrating trauma to the eye. Three of the

latter were complications of ocular surgery. The six exogenous cases collected by Rychener are abstracted here:

1. Römer,⁵ in 1902, reported the case of a four-year-old child who was injured with a knife. Severe iridocyclitis necessitated enucleation. Examination of the fresh specimen revealed multiple abscesses in the anterior vitreous and *Aspergillus fumigatus* was recovered by culture.

2. Budek,⁶ in 1914, reported a case which developed after two operations for retinal detachment. Blastomycetes were cultured from the exudate which filled the anterior chamber, but subsequently when the eye was eviscerated the organism could not be recovered. Budek assumed the infection spread into the operative site from the conjunctival sac, thence to the vitreous and anterior uvea. He observed that this infection did not progress with the rapidity of a bacterial endophthalmitis.

3. Fuchs,⁷ in 1919, described the case of a 65-year-old woman who acquired a chronic iridocyclitis 6 months after cataract extraction. Enucleation was performed a year and a half later. Upon histopathologic study, an abscess containing granules resembling those of actinomycosis was found in the ciliary body below. Since the patient exhibited no other evidence of actinomycosis, Fuchs concluded the fungus had entered the eye during cataract extraction.

4. In 1924, Verhoeff,⁸ reported the case of a 30-year-old patient with chronic iridocyclitis which followed an operation for con-

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genital cataract. Although the operation was performed on one eye only, both eyes became involved by the chronic inflammatory process and both were enucleated a year later. Military abscesses containing actinomycotic granules were found in both eyes. Verhoeff concluded the infection developed during surgery and spread hematogenously from one eye to the other.

5. Balbuena,⁹ in 1925, reported the case of a four-year-old child who received a penetrating wound and subsequently developed a purulent endophthalmitis. Inoculation of the purulent material into a rabbit eye produced an exudate in which a fungus could be seen microscopically. The fungus was not identified by culture.

6. Rychener's own case⁴ was one which followed a penetrating wound by a splinter. The foreign body was removed and the wound repaired. On the eleventh day after surgical repair, the eye became painful and iridocyclitis was evident. The eye was enucleated 10 days later. Examination of the globe revealed an abscess in the anterior vitreous directly across from the site of penetration. A few vegetable cells were found along the path of injury. Mycelial forms of a fungus believed to be a species of *Aspergillus* were found in the abscess.

Relatively few reports of postoperative or post-traumatic mycotic infection have been made in the 25 years that have elapsed since Rychener's paper was published. In 1956, de Quieroz¹⁰ presented a case of posttraumatic fungus endophthalmitis at a Brazilian Ophthalmological meeting. This will be described later (Case 3).

Greetham and Makley¹¹ in 1957, reported a case of intraocular fungus infection following cataract extraction. They suggested that the fungus was "probably introduced with the capsule forceps as shown by the location of the abscesses, that is, at the incision and the opposite leaf of the iris." This patient received intensive antibiotic and steroid therapy. Greetham and Makley called attention to the rather long latent period be-

tween surgery and appearance of the inflammation (four weeks).

In 1958, Veirs and Davis¹² reported a case of fungus infection of the anterior chamber which developed after a penetrating injury by a thorn. The eye quieted down upon removal of the thorn, but soon became red and painful again. A whitish mass was found on the back of the cornea at the end of the wound. Treatment consisted of atropine, hydrocortisone, neomycin and hot packs. The eye responded to this therapy for a while, but the inflammation recurred on discontinuing medication. Finally the whitish material was removed by an ingenious surgical procedure and examination of the specimen revealed septate mycelia of a fungus which was not identified by culture. Uneventful recovery followed the operation. The similarity of this case to one of our own series in which a mycotic abscess formed at the end of a paracentesis wound is quite striking (Case 13).

Foster and coworkers¹³ have observed three postoperative infections of the eye caused by a fungus identified as a species of *Volutella*. Two of the infections occurred in a patient who had undergone bilateral cataract extraction. The first sign of endophthalmitis appeared nine days after the first operation. The patient was treated with oral and topical Mycostatin, oral chloromycetin and intramuscular penicillin but the eye was enucleated on the 47th postoperative day. A pure culture of *Volutella cinerescens* was obtained and histologic examination revealed an anterior chamber abscess in which numerous spores and branching hyphae of the fungus could be demonstrated with the Gridley stain but not with hematoxylin and eosin. The early signs of postoperative endophthalmitis appeared in the second eye 31 days after its lens had been removed. Three gray nodules averaging 0.5 mm. in size appeared on the anterior surface of the vitreous near the pupillary border of the iris at the 6-o'clock position. Gray filaments extended radially about each central nodule. On the

36th postoperative day the patient was treated with intravenous Amphotericin B. This treatment was repeated a few times but discontinued when the minimal inhibitory concentration for the infecting organism was found to be five times higher than the maximal blood level of Amphotericin B. The drug was then administered topically in an ointment, subconjunctivally and intraocularly (anterior chamber). With this regimen the infection seemed to be controlled; the eye became asymptomatic but was blind. The third instance of postoperative infection with this same organism mentioned by Foster and coworkers occurred prior to their use of antifungal agents and progressed rapidly to enucleation.

To date we are therefore aware of only six instances of postsurgical and posttraumatic fungus infection of the intraocular tissues reported since Rychener's paper of 1933. It is our purpose, here, to report 13 such cases. These include the case presented at a Brazilian ophthalmological meeting by de Quieroz in 1956.¹⁰ We do not believe that any of these cases have been published previously.

MATERIALS AND METHODS

The cases selected for this report were all examples of exogenous fungus infection of intraocular tissues. Each case met two principal criteria: (a) there was a history of a surgical procedure or of other penetrating wound of the eye, and (b) the histologic sections of the enucleated eye revealed evidence of active proliferation of a fungus within the inflammatory lesions. Cases of intraocular fungus infection secondary to perforated corneal ulcers³ were excluded as were those cases in which only a few saprophytic fungi were contained on intraocular foreign bodies (see Wilder, 1948).¹⁴ Special stains for fungi and for bacteria were employed in every case. Either or both the methods of Gridley¹⁵ and Grocott¹⁶ were used for the demonstration of fungi while gram stains were made in an effort to reveal bacteria. No

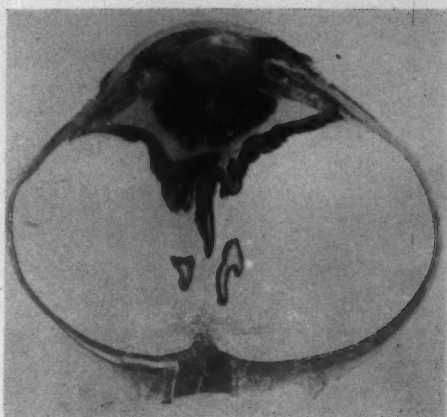


Fig. 1 (Fine and Zimmerman). Case 1 (AFIP Acc. 183807). Posttraumatic mycotic endophthalmitis. (Hematoxylin-eosin, $\times 4$)

bacteria were found in the cases to be reported here.

CASES FOLLOWING ACCIDENTAL TRAUMA

CASE 1 (AFIP Accession No. 183807)

On September 16, 1956, a 19-year-old white man was struck in the left eye with a piece of copper wire. An iridectomy was performed on the same day and the piece of wire removed. Convalescence was uneventful initially. Two weeks later there was evidence of intraocular hemorrhage and infection. Blood and pus were seen in the anterior chamber. The fundus was obscured and a diagnosis of panophthalmitis was made. The eye was enucleated on November 25, 1956, about two months after injury and surgery.

Upon opening the eye a cone-shaped detachment of the retina and a vitreous abscess were observed. Microscopic examination revealed an abscess within a perforating wound of the cornea near the limbus on one side (fig. 1). The abscess, which also filled and obliterated the anterior, posterior and vitreous chambers, contained large numbers of septate, branching, nonpigmented mycelia of a fungus (fig. 2). These averaged 4.5μ in width.

CASE 2 (AFIP Accession No. 741873)

A 33-year-old white man was in good health until January 8, 1956, when he suffered a penetrating injury to his left eye by a flying piece of nail. He was seen by his physician within the hour and was referred to an eye clinic. His visual acuity had become reduced to light perception. The patient was hospitalized, treated with penicillin and analgesics, but the wound was not sutured until four days later. The patient was discharged 10 days after the injury but the eye continued to be painful and in-



Fig. 2 (Fine and Zimmerman). *Case 1*. Septate mycelial forms of a fungus are present in large numbers throughout the abscess shown in Figure 1. (Gomori methenamine silver, $\times 350$.)

jected. Examination on February 15, 1956, revealed corneal bedewing. A conjunctival flap covered the lateral part of the cornea. Light projection was fair. The anterior chamber was present and there was a four-plus aqueous flare. A traumatic cataract prevented visualization of the fundus. X-ray films revealed no evidence of a radiopaque foreign body. Treatment consisted of topical cortisone and atropine and subconjunctival injections of adrenalin, cocaine and atropine to break up the posterior synechiae which had formed. Subjective and objective improvement followed but because of the persistence of iritis and the fear of sympathetic ophthalmia the eye was enucleated on February 21st. The postoperative course was uneventful and the nontraumatized eye remained quiet.

Upon opening the eye, an iris coloboma was seen on the temporal side. Mucoid material was present in the anterior chamber and the lens was swollen and opaque posteriorly. A mass of opaque white tissue projected from the peripheral retina and pars plana inferiorly. Microscopically, this was found to consist of a large number of microabscesses surrounded by contracted vitreous. Stains for fungi revealed a number of flattened, twisted, septate, nonpigmented mycelial structures averaging 4.5μ in width. Giant cells were present about fragments of these degenerating hyphae.

CASE 3 (AFIP Accession No. 743097) (Previously reported by de Queiroz²⁰)

An 11-year-old white girl was struck in the eye with a piece of wood. Secondary glaucoma super-

vened. The patient was given Diamox and Cortone drops topically for 20 days. The tension was reduced somewhat but then became uncontrollable. Parenteral penicillin and topical pilocarpine were administered but the eye was finally enucleated. The general health of this patient was considered to be good. A calotte of the enucleated eye was submitted in consultation. Sections of the calotte did not reveal the site of penetration. There was marked congestion of the limbal vessels. The anterior chamber was obliterated by the apposition of the iris to the cornea. A small piece of lens material lay against the iris. A large abscess filled the area between the iris and a broad band of hemorrhagic scar tissue which traversed the globe in the plane of the ora serrata (fig. 3). Although the abscess was composed mainly of disintegrating polymorphonuclear leukocytes, a zone of epithelioid and giant cells surrounded it. The abscess contained a large number of branching septate mycelia averaging 2.5μ in width (fig. 4). Occasional degenerating globoid forms were present but no specialized reproductive or sporulating structures were noted.

POSTOPERATIVE CASES

CASE 4 (AFIP Accession No. 551747)

An 86-year-old white man had a lens extraction in his left eye on July 22, 1952. Signs of uveitis appeared in this eye 11 days later. He was put on cortisone, both topically and systemically. Examination at the time of enucleation revealed aphakia, cloudy media and hypopyon. A diagnosis of endophthalmitis was made. The eye was enucleated on September 24, 1952.

Upon opening the globe in the vertical plane, blood was observed in the anterior chamber. An opaque gelatinous mass, adherent to the ciliary body was bound on one side, but the posterior segment appeared relatively uninvolved.

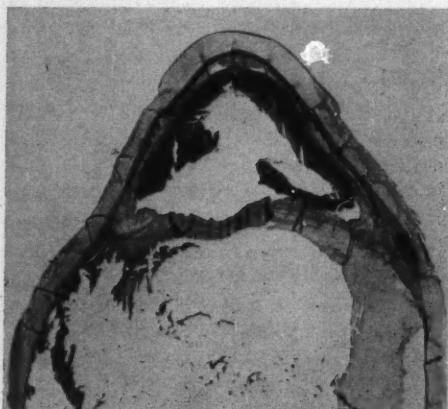


Fig. 3 (Fine and Zimmerman). *Case 3* (AFIP Acc. 743097). Posttraumatic mycotic endophthalmitis. (Hematoxylin-eosin, $\times 7$.)

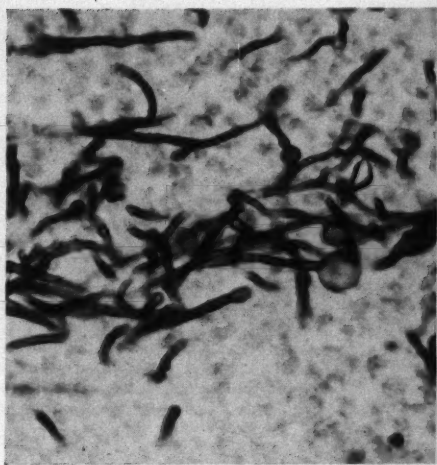


Fig. 4 (Fine and Zimmerman). Case 3. Gomori's methenamine silver stain reveals profuse growth of a fungus in the abscess illustrated in Figure 3. The globoid forms are interpreted as degenerating hyphae rather than specialized reproductive structures. ($\times 630$.)

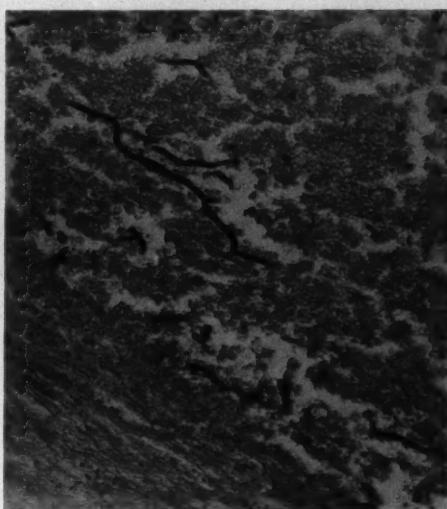


Fig. 6 (Fine and Zimmerman). Case 4. Many septate branching mycelial forms of a fungus are found in the abscess shown in Figure 5. (Gomori methenamine silver, $\times 305$.)

A limbal scar containing doubly refractile foreign bodies surrounded by multinucleate giant cells was observed on microscopic examination. The lens was absent. A delicate fibrinocellular pupillary membrane was present and a purulent vitreous abscess was found inferiorly, over the ciliary body (fig. 5). This contained numerous branching, septate mycelia measuring 2.5 to 3.5 μ in width (fig. 6). These fungi could be seen only when appropriately stained. An occasional giant cell was found at the periphery of the abscess.

CASE 5 (AFIP Accession No. 704188)

Lens extraction was performed in the right eye of a 74 year old white man in January, 1955. The postoperative course was described as uneventful and vision of 20/20 was obtained with suitable correction. On April 15, 1955, the patient returned complaining of pain in the right eye. Examination at this time revealed a red painful eye and an abscess in the fundus which appeared to be mixed with blood. The tension was 37 mm. Hg. The patient was admitted to the hospital the following day

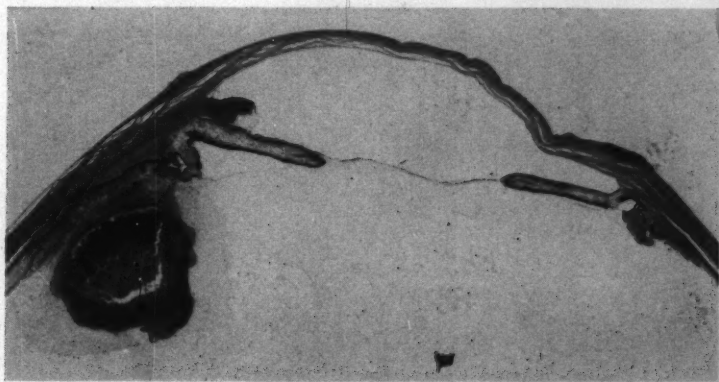


Fig. 5 (Fine and Zimmerman). Case 4 (AFIP Acc. 551747). A localized mycotic abscess is present on the inner surface of the ciliary body and peripheral retina inferiorly (on left side) and there is fibrinopurulent exudate in the lower anterior chamber angle. (Hematoxylin-eosin, $\times 6$.)

and a cyclodialysis was performed. The pressure was reduced but the inflammation persisted. At this time a white membrane was noted in the pupillary space. No antibiotics or other drugs had been administered. Clinical diagnosis of secondary glaucoma due to vitreous hemorrhage was made and the eye was enucleated on April 30, 1955.

Upon opening the eye in the laboratory multiple abscesses were found in the vitreous, varying in size from 1.0 to 5.0 mm. There was a clot of blood on the iris. The cloudy vitreous contained a few streaks of blood.

Microscopically, a fibrinous membrane layered with fresh blood anteriorly and proteinaceous exudate and degenerated vitreous posteriorly occluded the pupil. A discrete abscess which measured 1.0 mm. in diameter was present in the anterior vitreous immediately behind the blood-covered pupillary membrane (fig. 7). A more diffuse area of suppuration was observed in the vitreous inferiorly. Special stains revealed large numbers of branching, septate, nonpigmented mycelia, especially about the periphery of the abscess. These measured about 2.0μ in diameter. The posterior segment of the globe revealed but little inflammatory reaction.

CASE 6 (AFIP Accession No. 732020)

A 59-year-old Negress was admitted for enucleation of the right eye two years and two months after a combined intracapsular lens extraction had been performed. The patient was a known diabetic with retinitis proliferans, chronic glaucoma and a blood pressure of 180/80 mm. Hg. She did not do well following cataract extraction and was maintained on atropine and topical hydrocortone. Seven

months after cataract extraction a knife-needle incision of a plastic membrane on the face of the vitreous was carried out. A slowly progressive endophthalmitis ensued and finally almost all vision was lost. The tension at the time of enucleation was 12 mm. Hg. Ophthalmoscopic examination revealed the anterior chamber to be filled with white exudate which had originally seemed to protrude from the vitreous.

The left eye was aphakic with vision correctible to 20/80. The tension was 27 mm. Hg but the visual fields were almost full. There was moderate vitreous haze, some diabetic retinopathy but no glaucomatous cupping of the disc.

The right eye was enucleated with a diagnosis of endophthalmitis. The eye was opened in the vertical plane and the anterior chamber was found to be filled with a creamy material. Peripheral anterior synechiae and a cyclitic membrane attached to the posterior surface of the iris were present. A 2.0 mm. pigmented lesion was seen in this membrane.

Microscopic examination of the exudate contained in the anterior chamber revealed degenerating polymorphonuclear leukocytes, large pale-staining macrophages, and small clumps of mycelial forms of fungus. These were lightly pigmented, septate, branching, and averaged 2.5μ in diameter. A thick inflammatory membrane containing a number of giant cells covered the anterior surface of the lower iris leaf. The anterior vitreous bulged forward and its anterior face formed a membrane which covered the pupillary space and the coloboma of the superior iris leaf. It became continuous below with the inflammatory membrane covering the lower iris leaf. The rest of the vitreous cavity was relatively uninvolved.

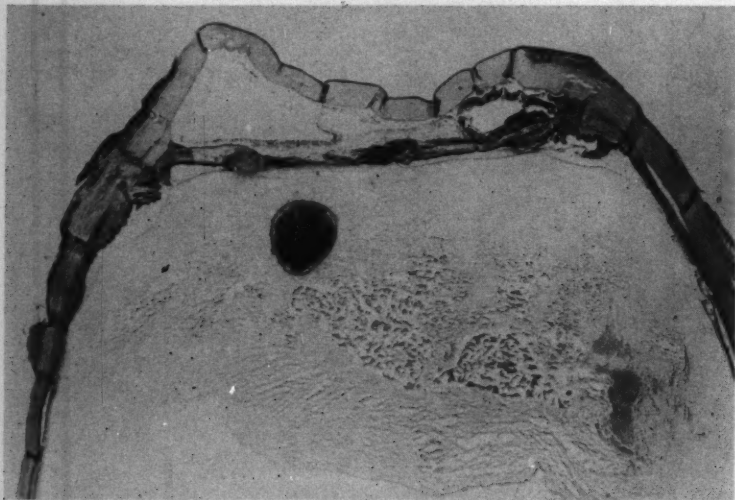


Fig. 7 (Fine and Zimmerman). Case 5 (AFIP Acc. 704188). A pupillary membrane is present and there is a discrete abscess in the anterior vitreous. (Hematoxylin-eosin, $\times 7$.)

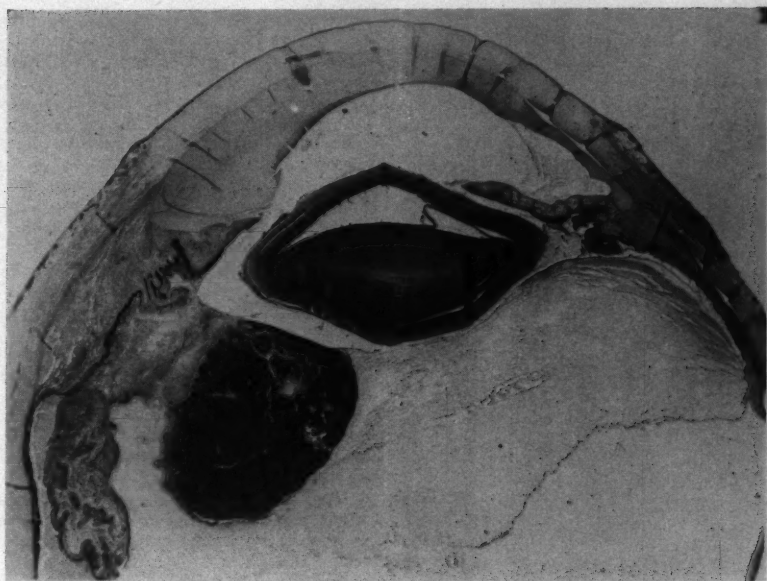


Fig. 8 (Fine and Zimmerman). Case 7 (AFIP Acc. 686094). A large discrete vitreous abscess is shown behind the lens on one side. (Hematoxylin-eosin, $\times 7$.)

CASE 7 (AFIP Accession No. 686094)

A 28-year-old white man was struck in the right eye with a piece of steel while working on his farm on October 7, 1954. He was examined within the hour and found to have 6/6 vision in each eye. There was a 2.0 mm. laceration of the conjunctiva and sclera at the 2-o'clock position, 2.0 mm. behind the limbus. Funduscopy revealed a fresh vitreous hemorrhage and a large metallic foreign body lodged in the vitreous. The foreign body could not be removed with the electromagnet; therefore, a new incision was made in the region of the ciliary body at the 4-o'clock position and carried down through the sclera. Reapplication of the magnet was rewarded by the removal of a steel sliver measuring 2.0 by 1.0 mm.

On admission the patient had been given a single injection of penicillin (600,000u.), a tetanus-thyphoid booster, and placed on chloromycetin, 0.5 gm., four times daily. The latter was continued for 10 days, during which time the eye cleared rapidly. By November 4, 1954, the visual acuity was 6/7 and the only evidence of injury that remained was a heavy collection of vitreous floaters. Treatment was discontinued and the eye remained asymptomatic until November 9, 1954, when the patient experienced a sudden onset of pain, redness, and loss of vision. Examination revealed an acute iridocyclitis with a one-mm. hypopyon. Treatment in the hospital included chloromycetin, achromycin and ACTH by intravenous drip (40u. per day for five days, then 20u. per day for three days). The

eye did not respond satisfactorily and continued to be very painful although the hypopyon cleared and the anterior segment inflammation subsided to a large extent. An inflammatory mass could be seen in the vitreous. This gradually enlarged in spite of treatment. Several foreign protein injections were given without any improvement and a cyclitic membrane formed despite continuous atropinization.

On December 4, 1954, the vision of the painful right eye was faint light perception. A whitish mass could be seen in the vitreous extending from the nasal periphery. The remaining vitreous was moderately hazy. A diagnosis of exogenous endophthalmitis secondary to intraocular foreign body was made and the eye was enucleated on December 6, 1954.

Macroscopic examination of the enucleated eye revealed a pale purulent exudate in the detached cloudy vitreous behind the lens in the lower nasal portion (fig. 8). Hemorrhage was present over the nerve head and a thick retinal fold extended from the disc margin to the equator on the nasal side.

Microscopic examination with the aid of special stains revealed large numbers of branching, septate mycelia of a fungus averaging 4.5μ in width, most noticeable in the periphery of the abscess (fig. 9). The retina was drawn up and folded on this side and the vitreous was detached. The remainder of the retina was in position and relatively normal.

CASE 8 (AFIP Accession No. 754542)

Lens extraction was performed in the left eye of a 69-year-old white woman on February 17,

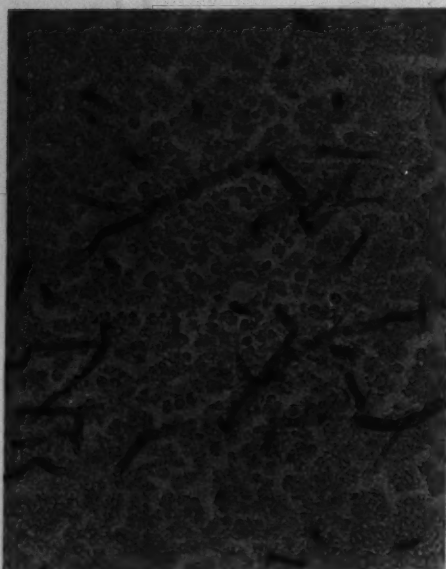


Fig. 9 (Fine and Zimmerman). *Case 7*. Branching septate hyphae are present about the periphery of the abscess shown in Figure 8. (Gridley stain, $\times 350$.)

1956, with uneventful operative and postoperative course. Visual acuity subsequently was 20/20 with correction. On March 16, 1956, a round pupil intracapsular lens extraction was performed in her right eye, also without incident. The postoperative course was uneventful and she was discharged on the 12th day. She received sulfonamides by mouth and topical atropine, cortisone and bacitracin while in the hospital.

On April 2, 1956, she was readmitted because of a choroidal detachment and shallow anterior chamber. She was given Diamox and eserine. Two days later the choroid appeared completely detached and the anterior chamber was flat. On April 4th a small incision was made down to the choroid in the lower temporal quadrant, the choroid touched with a diathermy needle, and a large amount of fluid evacuated. A large bubble of air was then placed in the anterior chamber. Following this the choroid returned to its normal position, the anterior chamber reformed, and the patient was discharged. Ten days later the corrected visual acuity was 20/25. Examination revealed an anterior chamber of normal depth, a one-plus aqueous flare, an intact hyaloid and a clear vitreous. Fundusoscopic examination was normal. Medication during this time consisted of topical atropine once and topical cortone (0.5 percent) three times daily.

On April 26th the eye became painful and on April 28 the patient returned for examination. There was marked ciliary congestion, a four-plus

aqueous flare, and an area of fibrinopurulent exudate on the anterior vitreous face adjacent to the pupillary margin of the iris at the 6-o'clock position. The exudate extended posteriorly into the inferior portion of the vitreous cavity. Corrected visual acuity was reduced to 20/40. The fundus appeared normal. The patient was hospitalized and placed on intensive antibiotic and steroid therapy, receiving ACTH for five days, chloromycetin and sulfonamides by mouth, and atropine and cortisone topically. The inflammation cleared rapidly and the patient was discharged nine days later.

Upon discharge the eye was white, the exudate which had previously been noted on the anterior vitreous had cleared completely, and the corrected visual acuity was 20/20-3. An occasional vitreous opacity could still be seen. The subsequent medication was chloromycetin by mouth and topical atropine and Metimyd.

Within 10 days there was a recurrence of acute ocular inflammation which increased in severity to such an extent that enucleation was performed after six days.

Upon opening the eye a pupillary membrane was found. Dense opacities and a small hemorrhage were observed in the anterior gelatinous vitreous behind the iris.

Microscopic examination disclosed a small amount of fibrinous exudate in the anterior vitreous and in the lower angle of the anterior chamber. The lens was absent. Other collections of inflammatory cells were present behind the lower iris leaf and over the adjacent pars plana (fig. 10). The exudate about these abscesses was continuous with that in the anterior chamber over the lower pupillary margin. Special stains demonstrated large numbers of branching septate mycelia of a fungus averaging just under 2.5μ in width (fig. 11). The organisms were localized to the abscesses.

CASE 9 (AFIP Accession No. 838057)

A 67-year-old white woman underwent intracapsular lens extraction on May 21, 1957, without

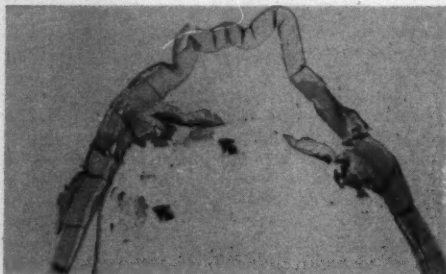


Fig. 10 (Fine and Zimmerman). *Case 8* (AFIP Acc. 754542). Mycotic endophthalmitis. Fibrinopurulent exudate covers the posterior surface of the iris leaf on one side and the inner surface of the ciliary body and peripheral retina inferiorly (arrows). (Hematoxylin-eosin, $\times 7$.)

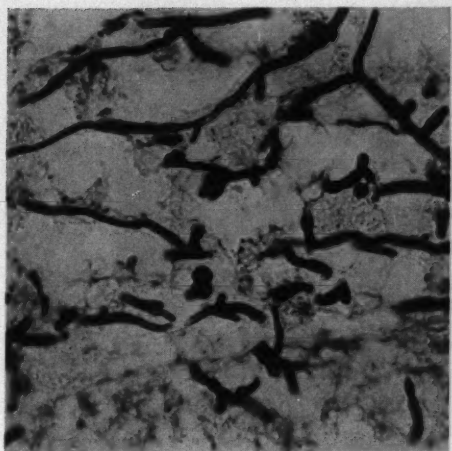


Fig. 11 (Fine and Zimmerman). *Case 8*. A profuse growth of septate mycelial structures is found in the exudate illustrated in Figure 11. (Gomori methenamine silver, $\times 630$.)

incident. Preoperative medication was topical Furacin for one week followed by penicillin ointment topically for one to two days. Postoperatively she received topical atropine and a topical antibiotic. When the sutures were removed on June 7th, the media were clear and the fundus appeared normal. On June 15, 1957, ciliary congestion, tenderness and a few scattered cells in the anterior chamber led to a diagnosis of uveitis. Treatment with cortisone drops, atropine ointment and systemic cortisone was begun. By June 21st, no improvement was evident and the patient was hospitalized for ACTH therapy. Her tension at this time was normal. After one week there was only slight improvement. ACTH was discontinued and oral Chloromycetin and sulfonamides were begun. An abscess appeared at the limbus at the incision site. This was opened and drained, but smears and cultures were not made.

At this time examination revealed an updrawn pupil and a hazy vitreous face suggestive of early endophthalmitis. Metacorten was discontinued. She was continued on Chloromycetin by mouth; combiotic and parenzyme were employed for several days and achromycin was added subsequently. There was no improvement and on July 9th the eye was enucleated.

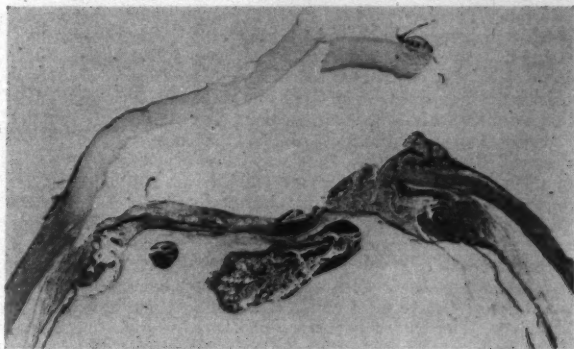
The partially collapsed eye was opened vertically. The anterior chamber was shallow. A white, opaque, gelatinous material covered the anterior surface of the iris. Purulent material was present in the anterior part of the semigelatinous vitreous. Microscopic examination revealed a gaping wound of the cornea near the upper limbus in which lens capsule, purulent material and iris tissue were incarcerated. This was continuous with a more fibrinocellular exudate that extended across the pupil to cover the front and back of the lower iris leaf. A multilobulated abscess was present immediately behind the pupillary membrane (fig. 12). Smaller pockets of purulent exudate were contained anterior to the pupillary membrane and behind the inferior iris leaf. With the aid of special stains for fungi the abscess was demonstrated to be heavily infiltrated with branching septate nonpigmented hyphae averaging about 2.0μ in width. There was diffuse leukocytic infiltration of the remainder of the vitreous and of the inner layers of the retina.

CASE 10 (AFIP Accession No. 868441)

On April 25, 1957, this 60-year-old white man was found to have cataracts in both eyes. Slitlamp examination showed the anterior segment to be clear and normal. The pupil dilated easily and light projection was good. An intracapsular lens extraction was performed on the right eye on April 30, 1957, under local anesthesia.

Examination on May 11, 1957, revealed a quiet eye, a clear anterior chamber and a slightly eccentric updrawn pupil. By May 24th, the eye appeared slightly red but vision was 20/40 with rough correction and the patient was told to return in three weeks for final refraction. On May 27th, the patient returned with the statement that the eye had been markedly inflamed for two days but was not

Fig. 12 (Fine and Zimmerman). *Case 9* (AFIP Acc. 838057). A large mycotic abscess is present behind a pupillary membrane. A small vitreous abscess is seen to the left of the larger abscess. (Hematoxylin-eosin, $\times 7$.)



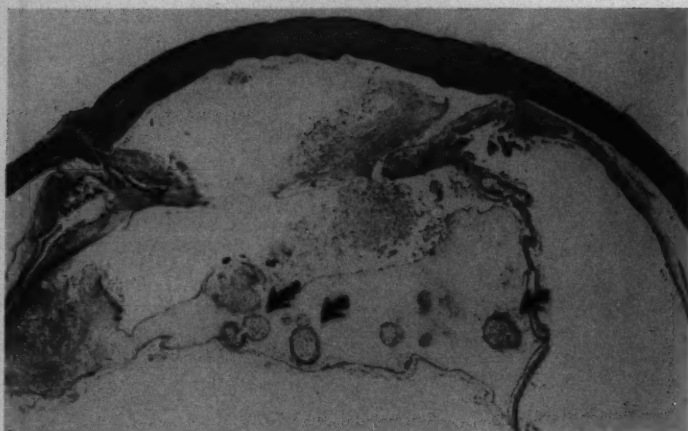


Fig. 13 (Fine and Zimmerman). *Case 10* (AFIP Acc. 868441). Many small discrete mycotic abscesses are seen in the vitreous (arrows); a larger lesion is present on the inner surface of the ciliary body on the left side of the picture. (Hematoxylin-eosin, $\times 7$.)

painful. Examination led to a diagnosis of uveitis and the patient was treated with metacorten by mouth six times daily, atropine ointment and topical Neohydeltrasol. Tension in the right eye at this time was 26.7 mm. Hg. On May 29th there was still a four-plus flare and cells in the anterior chamber with "considerable exudate in the pupillary space." The same medication was continued. By June 6th, there was some improvement and the fundus could be seen with difficulty. The medications were continued. The patient was also treated for pyelitis.

By July 8th, hypopyon, ciliary injection, and an irregular updrawn pupil were observed. Parenzyme and intravenous ACTH were administered. Seclusion of the pupil developed. By July 11th, the hypopyon had cleared but the iris was now adherent to the vitreous face in the area of the surgical coloboma and a four-plus flare was still present. Hypopyon reappeared on July 19th, and cortisone was increased. The hypopyon cleared by July 26th. By July 29th vision was 20/100 with a compound hyperopic lens. Delay in improvement resulted in hospitalization and ACTH therapy; subsequently typhoid vaccine treatment was added. Metacorten was stopped on the nineteenth of September. On September 25th, there was an exacerbation of the uveitis, with many cells in the anterior chamber. Typhoid vaccine and oral metacorten were resumed. By October 1st, there was much exudate in the anterior chamber, but the tension was still normal to palpation. Metacorten was continued. On October 3rd, paracentesis was performed. On October 4th, the paracentesis was reopened. On October 5th enucleation was performed.

When the globe was opened, the anterior chamber was found to be filled with a white fibrinopurulent mass. The lens was absent. The back of the

lower iris leaf and ciliary body was covered with thick gelatinous exudate. The vitreous, which was drawn forward, appeared markedly fibrinous. Suspended in it were large and small discrete flocculent bodies. The retina was thickened and its inner surface was covered with a shaggy, fibrinous material. Microscopically, all of the ocular tissues showed advanced autolysis. There was a healed scar of corneal perforation near the upper limbus into which a fold of the iris root had herniated. More peripheral sections showed some uveal material in the subconjunctival tissue. A dense fibrinopurulent exudate covered the surface of the iris and filled much of the pupillary area. Multiple, well-circumscribed abscesses of varying size were present throughout the vitreous, the largest overlying the ciliary body (fig. 13). With special fungus stains the abscesses were found to contain large numbers of slender, septate hyphae of a fungus which occasionally branched out at right angles. Its mycelial structures averaged 2.0μ in width. These hyphae were also found in large numbers in the fibrinopurulent exudate which extended from the pupillary area into the anterior chamber (fig. 14). Occasionally small clusters of ovoid, sporelike bodies which measured 5.8μ in length were found in association with the hyphal structures.

CASE 11 (AFIP Accession No. 883639)

An adult white woman underwent lens extraction in her left eye. The operation and postoperative course were uneventful. Visual acuity four months later with final correction, was better than 20/25. The eye remained perfectly clear until eight months after operation when signs and symptoms of uveitis suddenly appeared in the left eye. The patient was given topical atropine and cortisone, and metacorten by mouth. There appeared to be some

improvement during the next two weeks as the aqueous cleared. Medications were continued but the uveitis recurred in the following two weeks. Further therapy, which included intravenous ACTH, did not seem to halt the slow progression.

At this time a plastic pupillary membrane had formed through which could be seen a white mass behind the lower iris leaf. There was no iris bombé, light projection was good, and the tension was normal to palpation. At this late date a clinical diagnosis of postoperative fungus endophthalmitis was made and an attempt to halt it with intravitreal injections of Mycostatin was unsuccessful. The eye was enucleated almost four weeks after the diagnosis of fungus infection was first considered strongly.

The dependent abscess had spread through the pupil and into the anterior chamber. The inner layers of the globe were widely separated by a proteinaceous exudate. The pathologic anatomy in this case was altered somewhat by the attempts to treat the disease by intraocular medications. This case will be reported in greater detail elsewhere, since it is the only one in which we have personally had an opportunity to examine the patient and to make a clinical diagnosis of postoperative mycotic endophthalmitis.

CASE 12* (AFIP Accession No. 220077)

A 76-year-old white woman developed severe uveitis in her right eye 15 days after cataract extraction. She was treated with antibiotics, corticosteroids, and antihistamines without appreciable benefit. Physical examination and laboratory investigations revealed nothing contributory and the eye became progressively worse in spite of continued therapy. At the time of enucleation three and one-half months later, clinical examination revealed an intensely inflamed right eye. White exudate filled the pupil and appeared in the anterior chamber. When the enucleated eye was opened, cultures were made of the vitreous abscess. A fungus of the genus *Cephalosporium* was identified. Mycelia of a fungus were found in the remaining portion of the abscess on histologic examination. A diagnosis of intraocular *Cephalosporium* infection following cataract extraction was made.

CASE 13 (AFIP Accession No. 220214)

A white woman had an uncomplicated cataract extraction of the left eye about December, 1956. Following surgery a low grade uveitis appeared. This did not improve, and about six weeks after the operation a small irregular line was observed on the endothelial surface of the cornea. It remained small for four months and then progressed into a severe infection involving the deeper layers of the cornea. This patient had received Chloromycetin by mouth the night before surgery, the

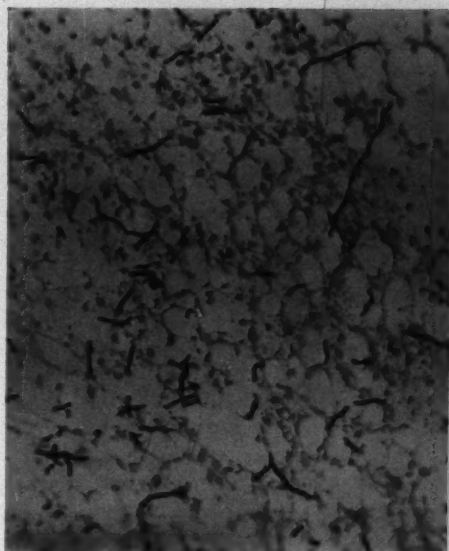


Fig. 14 (Fine and Zimmerman). Case 10. An abundance of mycelial structures is demonstrated in the large lesion on the inner surface of the ciliary body shown in Figure 13. (Gomori methenamine silver, $\times 305$.)

day of surgery and for 48 hours following surgery. Following the development of uveitis the patient was treated with corticosteroids.

Microscopic examination revealed a scar of cataract extraction and a deep corneal abscess in which mycelia of a fungus could be seen. This abscess, which extended to the inner end of the paracentesis scar, had ruptured through Descemet's membrane into the anterior chamber.

DISCUSSION

Hogan,¹⁷ in a symposium concerned with complications of cataract operations, points out that infections may be subdivided according to their time of onset (early or late), their source (endogenous or exogenous), their character (suppurative or nonsuppurative), and their extent (localized or diffuse). Following this schema we may summarize that most postoperative fungus infections are late, exogenous, suppurative lesions which usually are fairly well localized.

Hogan also points out that with low-grade bacterial infections there is usually persistence of inflammation from the time of sur-

* Cases 12 and 13 are reported here through the courtesy of the Francis I. Proctor Foundation, University of California School of Medicine, San Francisco.

gery. The infection may become more severe upon withdrawal of antibiotics. Most exogenous bacterial infections are well established by the second or third day. A late (endogenous) infection from a remote focus in the body after the fifth postoperative day is of rare occurrence these days, possibly because of the better general physical condition and care of patients subjected to elective ocular surgery.

Mycotic infections in general follow a more chronic course than do most of the common bacterial infections. Furthermore, their progress, if affected, is generally affected adversely by most antibiotics.¹⁸ When the response of the host is subdued by debilitating disease and/or by the administration of steroids the infection may progress more rapidly. This pattern appears reasonably well established in both the general medical and ophthalmic literature. Of the latter, Ley's contribution on experimental fungus infections of the cornea¹⁹ is perhaps the most outstanding. Ley demonstrated that the incidence of experimentally induced infections of the cornea in the young rabbit could be raised (from 20 to 80 percent) by applying cortisone to the traumatized cornea. Similar results have been obtained in our own laboratories.²⁰ Ley also demonstrated that a broad spectrum antibiotic used topically together with local cortisone treatment did not result in a lower incidence of fungus keratitis.¹⁹ Finally, he was also able to show that one antibiotic, oxytetracycline, when combined with the inoculum, potentiated *Candida albicans* infection of the immature rabbit's cornea.

From the cases which we have studied and from those previously published, we have been impressed by certain characteristic features of the clinical course of exogenous intraocular fungus infections especially those which have followed intraocular surgery.

1. LATENCY

There is a definite latent period varying from several days to several months between

the time of infection and the often sudden clinical appearance of the inflammation which results from that infection. An exogenous bacterial infection will usually announce itself within several hours or at the most a few days, and therefore a delay of much more than a few days is of considerable significance. This latent period is by no means diagnostic of a fungus infection but it should serve to introduce the possibility of a fungus infection into the differential diagnosis of postoperative and posttraumatic endophthalmitis. Presumably this characteristic latent period is related to the low order of pathogenicity and to the small numbers of organisms that gain entrance into the eye.

2. AN ANTERIOR SEGMENT DISEASE

The clinical progression of the endophthalmitis differs from that of bacterial infections (with particular reference to endophthalmitis following lens extraction). The inflammation presents as an iridocyclitis followed shortly by the formation of a plastic pupillary membrane, localized abscesses in the anterior vitreous, or a large white dependent mass behind the lower iris leaf and over the ciliary body. This tendency to localize results in a relatively clear vitreous elsewhere, at least early in the disease. Later an opaque pupillary membrane may form. If the pupil remains patent, a dependent abscess, upon enlarging, may spill over the lower iris leaf into the anterior chamber, giving the appearance of a segmental pupillary exudate. Occasionally, small white microabscesses may be seen early on the face of the vitreous.

3. PERSISTENT LIGHT PROJECTION

Because of the anterior localization of this disease, good light projection may remain for a remarkably long period. Histologically the retina remains relatively uninvolved until very late except for a few polymorphonuclear leukocytes along the inner surface of the retina and some nonspecific lymphocytic cuffing about the retinal vessels.

4. RESPONSE TO THERAPY

The initial anterior segment disease, treated as an ordinary spontaneous uveitis of unknown etiology (usually with antibiotics and steroids), will often respond quite dramatically at first with a marked reduction of the inflammation and apparent clinical improvement. A sudden exacerbation of the inflammation may occur within one or two weeks. The disease then becomes slowly progressive in spite of continuation, withdrawal, or alteration of therapy. Pain and uncontrolled progression of the endophthalmitis eventually lead to enucleation of the eye. Secondary glaucoma is uncommon.

Etiologic diagnosis is difficult. Even when confronted by a clinical pattern compatible with exogenous fungus endophthalmitis the procurement of a suitable specimen for culture is unrewarding as the infection does not usually localize well on the surface of the eye at the site of surgical penetration. Furthermore, in experimental animals positive cultures could be obtained only sporadically, even when material was aspirated from the vitreous.²⁰ This failure is attributed to the fact that the fungus was present only in its mycelial form and that a good sample of such material for culture cannot easily be obtained with a needle. This does not apply to fungi which in tissue remain as yeast forms (for example, *Cryptococcus neoformans* or *Histoplasma capsulatum*).

The organisms responsible for mycotic endophthalmitis have been identified by microbiologic methods in very few cases. Most of the cases we have studied contained only non-pigmented mycelial forms of fungi with septate hyphae. These probably represent species of *Aspergillus*, *Cephalosporium*, *Fusarium*, or *Volutella*. In none of these cases did we observe budding yeast forms suggestive of *Candida* species nor have we found actinomycotic granules.

The source of the infections is considered to be exogenous. Whether the fungi are carried into the globe on the penetrating instrument primarily, from the conjunctival sac

secondarily, or from the medications applied during or after surgery is impossible for us to determine. The frequent discovery of small bits of foreign material (cotton fibers, starch granules, and so forth) in and about surgical wounds in many eyes which we have studied after cataract extraction attests to the ease with which the even smaller spores of fungi might gain entrance.

The apparent increase in incidence of fungus infections would seem to be related to the widespread use of antibiotic and steroid preparations. Unfortunately we have been unable to obtain complete information about the use of routine pre- and postoperative antibiotics and steroids in the cases which we have reported here. The routine use of antibiotics and steroids might be significant in promoting the growth and pathogenicity of a few vagrant fungus spores. This might also occur by subduing a potential bacterial endophthalmitis and so permit an accompanying fungus to make its presence known. Ordinarily, such a contaminant as a few fungus spores would not be found on histologic examination of an eye removed because of bacterial endophthalmitis.

In view of the fact that specific etiologic diagnosis and therapy are so very difficult, certain recommendations concerning prevention of mycotic endophthalmitis may be made.

Because the organism might originate from either the conjunctival sac itself or from materials introduced into the eye: (a) preoperative preparation should not include steroids, and antibiotic preparations, if used, probably should be other than tetracyclines and should be limited to a short preoperative period; (b) the conjunctival sac should be *thoroughly* irrigated immediately before surgery; (c) greater attention should be given to sterilization of instruments and to solutions used for sterilization; (d) more care should be exercised in the use of multiple dose bottles of medication and saline in the operating room. Once a dropper-type bottle is opened in the air, the remaining material

should be considered as contaminated. Once such a bottle is opened it should not be allowed to stand overnight and then re-used. The use of smaller sterile aliquots is therefore highly recommended. Duhig and Mead have previously called attention to the possibility of contaminated medications playing a key role in the pathogenesis of systemic mycosis due to *Monilia albicans*.²¹ Furthermore, one of us (B.S.F.) has had occasion to observe the growth of a fungus in a bottle of five-percent dextrose in which the vacuum was broken momentarily and the bottle then allowed to stand for several days.

SUMMARY

There has been an increase in the number of reports of fungus infections of the cornea complicating other corneal disease, particularly in patients receiving prolonged antibiotic and steroid therapy. Less attention has been given to a somewhat parallel increase in the number of intraocular fungus infections following injury and especially following surgery.

The exogenous intraocular fungus infections collected from the literature and from the Registry of Ophthalmic Pathology have been reviewed. As a result of this study, there has emerged a realization that exogenous fungus infection presents itself as a rather distinctive clinical and pathologic entity. The clinical course is characterized by:

1. A latent period varying from several days to several months between trauma and the often sudden appearance of the intraocular inflammation.
2. A slowly progressive, localized infection of the anterior segment of the globe, which may be accompanied by formation of a plastic pupillary membrane or by the ap-

pearance of a white exudate in a segment of the pupil which may slowly advance from behind the iris into the anterior chamber.

3. Persistence of good light projection for a remarkably long period after appearance of the inflammatory process.

4. Rapid initial suppression of the inflammation by antibiotics and steroids followed by exacerbation and progression in spite of all therapy.

5. Enucleation because of pain and chronic inflammation.

Precise etiologic diagnosis is difficult and indiscriminate administration of antibiotics and steroids appears to be detrimental. Prophylaxis is all important.

ADDENDUM

Since this manuscript was submitted for publication, we have had an interesting experience which fortifies our belief that the clinical syndrome as described in this paper carried great diagnostic significance. Slides prepared from two enucleated eyes and excellent résumés of the respective clinical histories were received in consultation from a hospital pathologist. The two cases represented delayed postoperative endophthalmitis but in neither had an etiologic diagnosis been established. Review of the original slides failed to disclose a causative agent but the clinical histories and the character of the pathologic changes were so very typical of mycotic endophthalmitis that additional sections and special stains were prepared. We were rewarded in both instances by the demonstration of nonpigmented, septate mycelial structures of an otherwise unidentified species of fungus.

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CONGENITAL TOXOPLASMOSIS*

III. OCULAR SIGNS OF THE DISEASE IN STATE SCHOOLS FOR THE BLIND

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Recognition of that form of congenital toxoplasmosis in which only the eyes are seriously involved^{1,2} suggests a connection between this disease and the cases of bilateral and recurrent chorioretinitis in older children and adults seen so commonly in ophthalmic practice. This concept is not entirely new. Thought along similar lines³ was stimulated by the description of chorioretinitis as part of the clinical syndrome in the earliest reports on congenital toxoplasmosis. Lack of a prac-

tical serologic test and the prevalence of past infection in the general population confused the issue at that time. Now we can say with reasonable certainty that:

1. Congenital toxoplasmosis is much more frequent than previously supposed.
2. Its commonest form is that in which chorioretinitis is the only clinical manifestation of the disease.
3. Many cases of active chorioretinitis formerly thought of as being due to "acquired" toxoplasmosis are actually only recurrences of the congenital infection.

Confirmation of these beliefs would provide a new approach to the diagnosis and treatment of at least some cases of chorioretinitis. Little progress has been made in the past five years toward the complete under-

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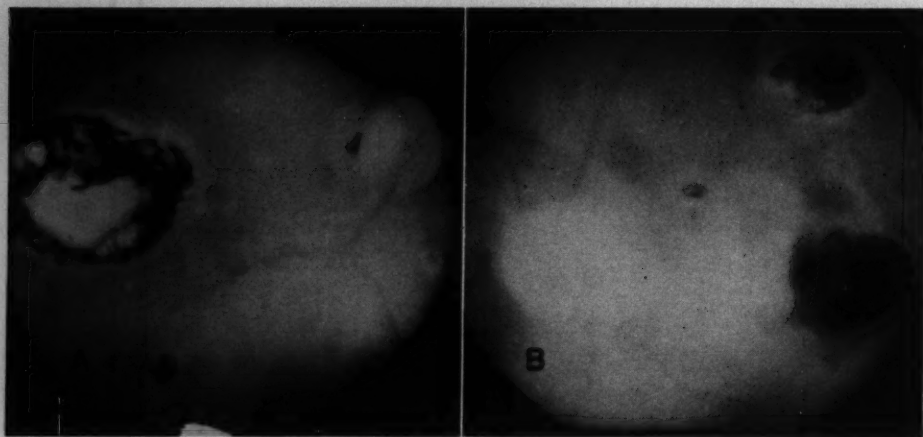


Fig. 1 (Fair). Bilateral central chorioretinitis of congenital toxoplasmosis. Recurrence of the inflammation took place in the left eye (B) at the age of 29 years. Vision in the right eye (A) had been poor since birth.

standing of either uveitis in general or chorioretinitis in particular. Wilder's⁴ description of toxoplasmic chorioretinitis from histopathologic preparations and the isolation of the parasite from a human adult case of chorioretinitis⁵ provided real impetus to the study of the common inflammations of the inner eye but the five years that have elapsed since have produced no actual gains. Toxoplasmosis is responsible for a large proportion of the usual variety of chorioretinitis but we still, in any given case, are unable to make more than a presumptive diagnosis because of the frequency of past or persistent toxoplasmosis in the general population. In addition, the natural course of the ocular infection with its recurrences and remissions makes it difficult to assess the effect of treatment by chemotherapeutic means. Any improvement in either diagnosis or treatment would be a welcome relief.

It is my experience, as reported previously,² that a large percentage of those cases of chorioretinitis seen in older children and adults are bilateral recurrent affairs with long histories of disturbance in vision or the squint and nystagmus indicative of a congenital origin (fig. 1). The suggestion that many of these cases are ex-

amples of the ocular form of congenital toxoplasmosis does not seem unreasonable when the results of serologic tests for toxoplasmosis in these patients and their mothers are considered. If the time and trouble is taken to locate the mothers, positive serologic tests in both mother and offspring will be found in an extremely high percentage of those examined, a situation which greatly enhances the diagnostic importance of these tests since only about one out of four individuals in the young adult population might be expected to show serologic evidence of past infection.

It was in the further pursuit of such ideas that the present study was undertaken. Somehow the incidence of congenital toxoplasmosis must be determined. If the disease is responsible for a significant amount of chorioretinitis, then its treatment becomes a matter of prevention by protection of previously uninfected pregnant women. Ocular damage present at birth can never be treated successfully except by preventive means. Before interest in such an undertaking can be aroused, it must be shown that congenital toxoplasmosis is common enough and serious enough in its effects to make its prevention worthwhile. Determination of the inci-

dence of the disease is not going to be easy, chiefly because its manifestations are often limited to the eyes and so are not detected except by the ophthalmologist. Unfortunately, eye clinic figures cannot be applied to the general population. Frequency of the congenital infection might be estimated from the incidence of the acquired disease but such an estimate would have to be supported by clinical observations. This means case finding on a large scale.

Because of the tendency toward bilateral involvement of the macula in congenital ocular toxoplasmosis, one might expect to find cases of this sort grouped in schools for the partially sighted and blind. It is the purpose of this paper to report the results of a survey of three such schools operated by the states of Georgia, South Carolina and Tennessee. As will be shown, the chorioretinitis of congenital toxoplasmosis is an important cause for admission to schools for the blind. Using the skin test and ophthalmoscope, a number of typical cases were located in each school visited. The figures involved support the impression that congenital toxoplasmosis is a public health problem of considerable magnitude but, again, the results are not applicable in any attempt to estimate the frequency of the disease. Bilateral central chori-

oretinitis may be characteristic of congenital toxoplasmosis but the commonest situation is that in which the macula in only one eye is affected, the other eye being spared completely or showing only peripheral scars (fig. 2). Such cases, of course, would not be located in schools for the blind. However, the ease with which numerous examples of the congenital infection can be found does suggest that it is worthy of a real effort at prevention.

PROCEDURE AND RESULTS

The routine used in surveying each state school was the same. Each student was first skin tested for toxoplasmosis. The antigen utilized was an unrefined preparation of heat-killed RH strain *Toxoplasma* in mouse peritoneal exudate diluted 100 times. Comparison with skin test antigen prepared after the method of Frenkel⁶ had previously shown no difference in results. Skin tests were controlled by the injection of a suspension of uninfected mouse spleen. After 48 hours, skin tests were read and at the same time a brief eye examination was done. Students with chorioretinitis were separated for more complete study which included: (1) dilation of pupils for more detailed funduscopic examination, (2) dye test for toxoplasmosis,

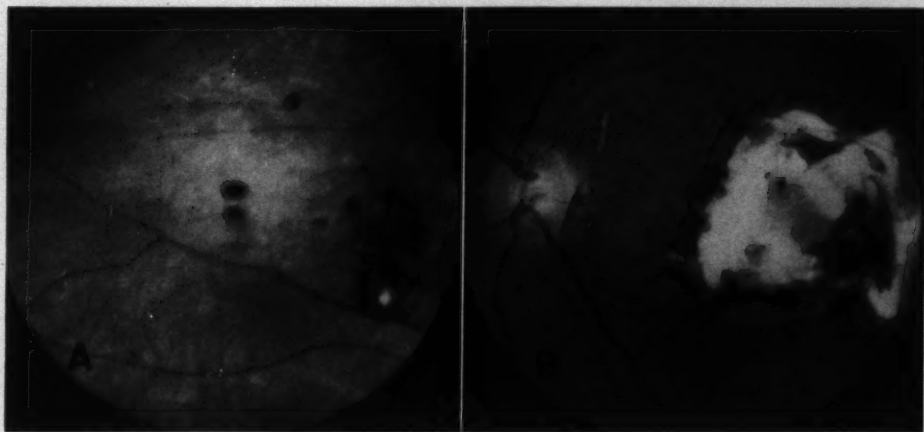


Fig. 2 (Fair). Most common ocular findings in congenital toxoplasmosis. In one eye (B) there is a large healed central lesion. In the opposite eye (A), only a healed peripheral scar is noted.

TABLE 1
RESULTS OF SKIN TEST FOR TOXOPLASMOSIS IN 467
STUDENTS IN STATE SCHOOLS FOR BLIND

	Positive	Negative	% Positive
Students with Chorioretinitis	22	4	84
Students with Other Eye Diseases	75	366	17
Totals	97	370	

(3) skull X-ray studies for intracerebral calcifications, and (4) a brief history as to birth and early development, complications during the pregnancy, age at discovery of poor vision or "dancing eyes," presence or absence of convulsions, mental status, and so forth. This information was obtained from each mother who was available together with a specimen of her blood for the dye test.

Tables 1 and 2 show the results obtained. Cases of chorioretinitis were easily recognized. In a few children with chorioretinitis, one eye was completely disorganized while in the other the lens was partially cataractous or the vitreous so filled with exudate that the fundus was made out with difficulty but, as a rule, the diagnosis was easy. The typical case was that of bilateral involvement of the macula with scattered peripheral scars. Ocular nystagmus and squint were constant findings as was high myopia. As a matter of fact, these cases form a group quickly separable from the congenital cataracts, the congenital glaucomas, the hereditary retinal degenerations and the several other classes into which blind children can be divided according to diagnosis. The one difficulty encountered was the occasional case of bilateral extreme microphthalmos or bilateral complete disorganization of the globe in which fundoscopic examination was impossible. Conceivably some of these situations are due to congenital toxoplasmosis but in this study they were not classed as such regardless of the results of the skin test.

Because there is no racial or geographic difference in the figures for the three schools,

these are grouped together in Table 1 which shows the results of the skin test in a total of 467 students examined. Of this total 26 were found to have chorioretinitis and of these, 22 or 84 percent gave positive skin tests for toxoplasmosis. Of the remaining 441 students (with eye disease other than chorioretinitis), 75 or 17 percent showed positive skin tests, a very significant difference between the two groups in this regard. The number of positive skin tests in those children without chorioretinitis approximates that to be expected in the same age groups in the general population. Dye tests were positive in all cases of chorioretinitis with positive skin tests and negative in those with negative skin tests.

Four of these 26 cases of chorioretinitis gave negative skin and dye tests for toxoplasmosis. Of these, three were indistinguishable clinically from those who gave positive tests, the fundi showing large healed central lesions and other peripheral scars. In the fourth of these four cases, the fundi showed small punched out central and peripheral chorioretinal scars typical of neither congenital toxoplasmosis nor congenital syphilis. Serologic test for syphilis in this case was negative. No history was available.

As already mentioned, serologic testing of the mothers of cases of chorioretinitis is essential in establishing a diagnosis of congenital toxoplasmosis. Past or persistent infection in the general population as manifested by the frequency of positive serologic tests tends to detract from the significance of a positive test in the individual case of

TABLE 2
RESULTS OF DYE TEST FOR TOXOPLASMOSIS
IN PATIENT AND MOTHER IN 20 CASES OF
CHORIORETINITIS LOCATED IN TWO STATE
SCHOOL FOR THE BLIND

Dye Test Positive in Both Patient and Mother	Dye Test Negative in Both Patient and Mother	Dye Test Positive in Patient, Negative in Mother
15	3	2

chorioretinitis. Perhaps one out of four young adults can be expected to react positively to the skin test so that it is in only a series of cases that the skin and dye tests develop some meaning. In this particular series, 84 percent of the cases of chorioretinitis gave positive skin tests for toxoplasmosis as compared with 17 percent in the group made up of other eye diseases. These figures certainly indicate a connection between chorioretinitis and toxoplasmosis but if we now can show that the mothers of the first group of children also have been infected, then the association with toxoplasmosis is many times more certain since under ordinary circumstances only about 25 percent of these mothers would give positive tests.

Mothers were available for study in 20 of the 26 cases of chorioretinitis. Table 2 correlates the serologic findings in mother and offspring. In 15 of these 20 cases, the dye test was positive in both mother and child, a very unlikely circumstance unless there were some connection between congenital toxoplasmosis and the eye inflammations under investigation. The dye test was negative in both mother and child in three cases. These are the same three cases described above in which the chorioretinal scars were identical with those of the typical case of congenital toxoplasmosis. Obviously, these three cases are not due to toxoplasmosis. It was fortunate that none of these three mothers had ever acquired toxoplasmosis because a positive result in a mother would have thrown doubt on the accuracy of the dye test in her offspring, leaving us uncertain as to the possibility of a congenital toxoplasmosis. In the fourth and atypical case of chorioretinitis with a negative skin test, the mother was unavailable for study.

In the two remaining cases of the 20 in which the mother could be located, the dye tests were positive in the children and negative in their mothers. These situations are the most difficult to explain and will be considered in the discussion to follow.

DISCUSSION

In schools for the blind, congenital cataract accounts for about 50 percent of admissions. The remaining 50 percent of the student body can be broken down into several small groups according to diagnosis. The most important of these are congenital glaucoma, hereditary degenerations of the retina, albinism, congenital myopia, optic atrophy and chorioretinitis. Less important in point of numbers are retrolental fibroplasia, external diseases, congenital syphilis, injuries and retinoblastoma. In this study of 467 students, chorioretinitis was responsible for only five percent of admissions but aside from congenital cataract it was just as frequent a cause for admission as was any other eye disease.

The combination of chorioretinitis—typically bilateral and central—together with positive serologic tests in both mother and child in 15 of the 20 cases of chorioretinitis in which the mother was available for study points directly at congenital toxoplasmosis as the causative factor. In no one of these 15 cases is the diagnosis absolutely certain since there is the slight possibility that both the student and his mother had acquired toxoplasmosis in the past but taken as a group it must be admitted that the evidence is strongly in favor of congenital infection.

This study of chorioretinitis was begun with several fixed ideas on the subject which were the result of five years' experience in the uveitis field. Some of these ideas have withstood the test of this investigation and others have had to be altered or abandoned entirely. I should like to discuss these matters individually beginning with those that have proved false.

First, it was my impression that all cases of central chorioretinitis were the result of congenital toxoplasmosis. In 50 or 60 cases seen previously, I had yet to find one in a child or adult in whom serologic evidence of toxoplasmosis was lacking. Further, of the many cases studied earlier in which the mother was available for serologic testing,

only one had been found in which there was a discrepancy in dye test results between patient and mother, the mother's skin and dye test being entirely negative.

It was a surprise, then, to encounter among 26 children with chorioretinitis, four cases in which there was no serologic sign of toxoplasmosis. In three of these, as mentioned, the chorioretinal scars were indistinguishable from those considered typical of congenital toxoplasmosis. In these same three, dye tests for toxoplasmosis performed on the sera of the mothers were negative.

One obviously cannot fall back on the theory of reversal of the dye test to negative in an occasional case. Too many people and too few years are involved. It seems certain that some agent other than the *Toxoplasma* was responsible for these cases of congenital chorioretinitis. The similarity in the history and clinical findings means that this type of case will have to be differentiated from toxoplasmosis by serologic means alone.

Which infectious agent to suspect becomes the next problem. Our only lead is the remarkable parallelism between congenital toxoplasmosis and generalized cytomegalic inclusion disease in the newborn. Until more is known, we will have to content ourselves with the knowledge that a certain small number of cases of congenital central chorioretinitis are caused by some infection other than toxoplasmosis.

Ten years ago, Sabin and Feldman⁷ pointed out the existence of cases of "chorioretinopathy" and other signs of cerebral damage in childhood that were identical to classical cases of congenital toxoplasmosis but gave negative serologic tests for that disease. Apparently the unknown agent may have its clinical manifestations limited to the eyes also and so be confused with cases of congenital toxoplasmosis in which only the eyes are seriously involved. At any rate, it has to be admitted that congenital toxoplasmosis is not the only cause of congenital chorioretinitis.

Another concept which has been weakened

by the results of this study is the idea that in an occasional case of many years' duration, the skin and dye test may revert to negative. We know that dye test titers fall gradually after the acute phase of acquired toxoplasmosis and that in animals at least, infection may persist in the brain although serologic tests have become negative. One strain of *Toxoplasma* differs from another in its ability to stimulate antibody formation and human hosts do vary in their response to infection. I have produced a dye test titer of 1:32,768 in one previously uninfected human volunteer with the same dose of heat-killed *Toxoplasma* that left another volunteer's dye test titer unchanged from negative.

Still, I would hesitate to accept as congenital toxoplasmosis any case in which the mother's dye test was completely negative. The two cases in this series in which children with congenital central chorioretinitis and positive skin and dye tests were found to have mothers in whom there was no serologic sign of toxoplasmosis are more likely explained on the basis of acquisition of toxoplasmosis by the children at some time in their lives than by the theory that they are both cases of congenital toxoplasmosis in which the mothers' dye tests had reverted to negative. This does not mean that the eye inflammation was due to acquired toxoplasmosis but, instead, that it was not due to toxoplasmosis at all, the positive skin and dye tests being the result of toxoplasmosis acquired incidentally just as it was incidental in 17 percent of all the students with eye disease other than chorioretinitis. The ages of these two children were nine and 10 years. Many youngsters in this age group give positive tests for toxoplasmosis, another feature of this study which is supported by the findings in surveys of other large groups of children with no or noninflammatory eye disease.

In the past, I have attached a great deal of importance to positive tests for toxoplasmosis in children suspected of congenital infection because of chorioretinitis. The relationship between a positive dye test and chorio-

retinitis is much more likely to be causal in a youngster than in an adult who has had many years in which to acquire the infection. Since 1956 I have skin tested about 2,500 subjects in hospitals and institutions of one kind or another. After elimination of all cases of congenital toxoplasmosis and all those of inflammatory eye disease there remained 287 children in this series in the six through 10 year age group. Of these, 30 or 10 percent gave positive skin tests for toxoplasmosis. In the three schools for the blind, nine percent of 116 children six through 10 years of age showed positive skin tests (cases of chorioretinitis eliminated). Even in this age group then, there is one chance in 10 that positive serologic tests for toxoplasmosis may be unconnected with chorioretinitis or signs of brain damage. The importance of the additional evidence furnished by serologic testing of the mother becomes apparent.

The experience gained in this study strongly supports the belief that chorioretinitis is the most constant finding in congenital toxoplasmosis and that the eye inflammation may be the only clinical manifestation of the disease. There were very few additional signs of congenital toxoplasmosis in the children in any of the three schools. In those 15 students with chorioretinitis and positive tests for toxoplasmosis in both mother and child, intracerebral calcifications were noted in three cases. Mentality was borderline in one of these but in none of the other 14. One child had a history of convulsions with fever years before.

In the group of three students with chorioretinitis and negative dye tests in mother and child, one suffered epileptiform seizures and had borderline mentality. In the two students with chorioretinitis and positive dye tests whose mothers were negative serologically, one child was slightly subnormal mentally and the other showed one small calcification in the lateral view of the skull which could not be located on the postero-anterior film. Two children with chorioretinitis and

positive skin and dye tests whose mothers were dead had borderline mentalities. One of these was thought to be "epileptic" as a baby but outgrew her convulsions. In three cases whose mothers were not available for study, no skull X-ray studies of the students were made. In these three, mentality was normal and there was no history of convulsions.

CONCLUSIONS

This investigation is part of an over-all plan aimed at establishing the incidence of congenital toxoplasmosis. All that it has attempted to show is that congenital toxoplasmosis is a common cause for admission to state schools for the blind. Other phases of the larger study include a survey of 1,700 mentally retarded children in state institutions already accomplished⁸ and the plan to examine several thousand public school children in a search for congenital chorioretinitis.

If it can be shown by studies of this kind that congenital toxoplasmosis is responsible for a significant amount of visual disability and mental retardation then perhaps it will be worthwhile to investigate the possibility of immunizing previously uninfected pregnant women in an attempt to prevent the congenital infection. Case finding must be expanded until a reasonable estimate of the incidence of congenital toxoplasmosis can be made. This study has convinced me that the disease is an important cause for admissions to schools for the blind. Surveys of schools for mentally retarded children produce small numbers of more severely affected cases. Although impressive by themselves, these figures do not reflect the true incidence of congenital toxoplasmosis since in its commonest form there may be only a central chorioretinitis in one eye combined with a personality defect or emotional instability or perhaps no mental change whatever.

SUMMARY

1. A survey of 467 students in state schools for the blind revealed 26 cases of

chorioretinitis. Of these, 22 or 84 percent gave positive skin tests for toxoplasmosis compared with 17 percent positive in the remaining 441 students. Twenty mothers were available for serologic study. Fifteen students with positive skin and dye tests had mothers with positive dye tests, suggesting congenital toxoplasmosis as the cause for the chorioretinitis in these cases. Three children with chorioretinitis gave negative skin and dye tests as did their mothers, indicating that some infectious agent other than *Toxoplasma*

may cause congenital chorioretinitis. In two cases, dye tests were negative in the mother of a child with a positive skin and dye test for toxoplasmosis. The significance of this finding is discussed.

2. It is suggested that congenital toxoplasmosis is a public health problem worthy of real concern. Further studies are proposed with the idea of establishing the incidence of the disease.

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RETINAL METASTASIS OF MALIGNANT MELANOBLASTOMA*

A CASE REPORT

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WILLIAM C. WILKINSON, M.D.
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Metastatic neoplasia in the retina is exceedingly rare. Why this should be is largely unexplained but the fact of rarity is unquestioned. A review of the literature reveals only seven cases of retinal metastasis, three being carcinomas (Arisawa,¹ Sattler,² Smoleroff and Agatston³) and the remainder sarcomas and melanoblastomas (Scheiss-Gemu-seus and Roth,⁴ Heine,⁵ Boente,⁶ and

Uhler⁷)†. Of the former the first was originally considered by the author to be a primary retinal carcinoma but probably represented a metastasis from an abdominal primary. The remaining two were found to be primary in pancreas and in stomach. Of the sarcomas one was a round cell type involving the disc and adjacent retina, and two were malignant melanomas also localized to the

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†Another case of a metastatic carcinoma to the retina from a uterine carcinoma was recently reported by Duke and Walsh (*Am. J. Ophth.*, **47**:44, 1959).

papilla and juxtapapillary area. The last reported case (1940) was a malignant melanoblastoma replacing the inner retinal layers immediately adjacent to the ora serrata and found on routine postmortem pathologic examination of the globe. All reported cases died of widespread metastatic disease. This is a report of a case of retinal metastasis of a malignant melanoblastoma diagnosed ante mortem.

CASE REPORT

A 43-year-old white man was seen in the eye clinic of the Ann Arbor Veterans Administration Hospital on September 9, 1958, on refer from the medical ward with a request for a funduscopy examination for possible retinal metastasis of widespread malignant melanoblastoma. When the referring physician was questioned later he stated that he had not seen the lesion but had thought this was a common finding. This is reminiscent of the storied intern who after a five-minute exam made an admitting room diagnosis of carcinoma of the tail of the pancreas which was later confirmed at postmortem. When questioned about his amazing acumen he answered, "What else causes pain in the back?"

Our patient had first presented himself to his physician with subcutaneous lumps on the side of the neck and on the hip in the summer of 1957. A biopsy of the hip mass was reported as malignant melanoblastoma, probably metastatic, by Dr. M. F. Vidoli of St. Vincent's Hospital, Toledo, Ohio. The patient was then referred to the Veteran's Administration Hospital where he was followed as an outpatient until a suspected cerebral metastasis caused admission on September 4, 1958.

The ocular examination revealed uncorrected visual acuity of 20/20, O.U., and was completely normal in all respects except for a small area of retinal hemorrhage in the temporal midperiphery, O.D., one disc diameter in size. The well-delineated hemorrhage surrounded a small venule which in turn had a dense white sheathing of irregular borders. This cuffing material extended laterally in minute masses into the hemorrhagic area. No pigmentation could be seen. A diagnosis of retinal metastasis was made. The patient's course was rapidly downhill and he died on September 22, 1958. The eye was removed for pathologic examination at the time of postmortem. Gross autopsy revealed extremely widespread metastasis of malignant melanoblastoma, death being due to brain involvement.

HISTOLOGIC REPORT

The right globe of the patient was fixed in formalin and opened 24 hours later. The retinal lesion was macroscopically seen in the midperiphery at about the 9-o'clock position. It was round and of dark-brown color. Its diameter was about 1.5 mm. No other pathology was seen at macroscopic examination. The globe was then imbedded in paraffin and cut horizontally in serial sections which included the lesion. The sections were stained with hematoxylin-eosin.

Microscopically the lesion was found to be limited to the inner layers of the retina; the nerve fiber, ganglion cell, and inner plexiform layers. No rupture of the inner limiting

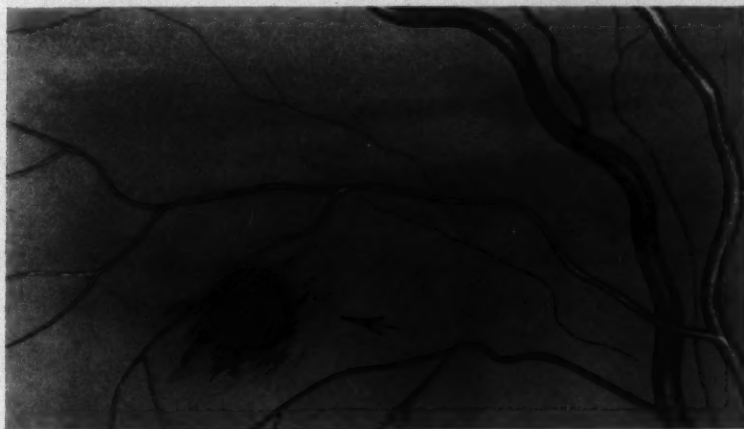


Fig. 1 (Liddicoat, Wolter and Wilkinson). Artists conception of the fundus lesion seen in the temporal midperiphery, O.D.

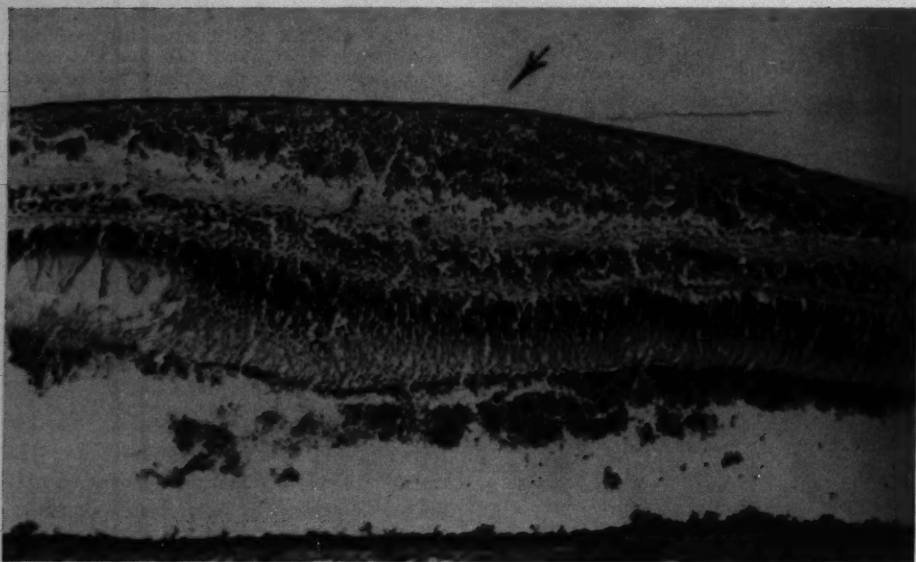


Fig. 2 (Liddicoat, Wolter and Wilkinson). Section through the periphery of the metastasis in the retina. The ganglion cell and nerve fiber layers are replaced by neoplasm (arrow). The outer retinal layers are not involved. Some exudate is seen in the retroretinal space. (Hematoxylin-eosin, photomicrograph.)

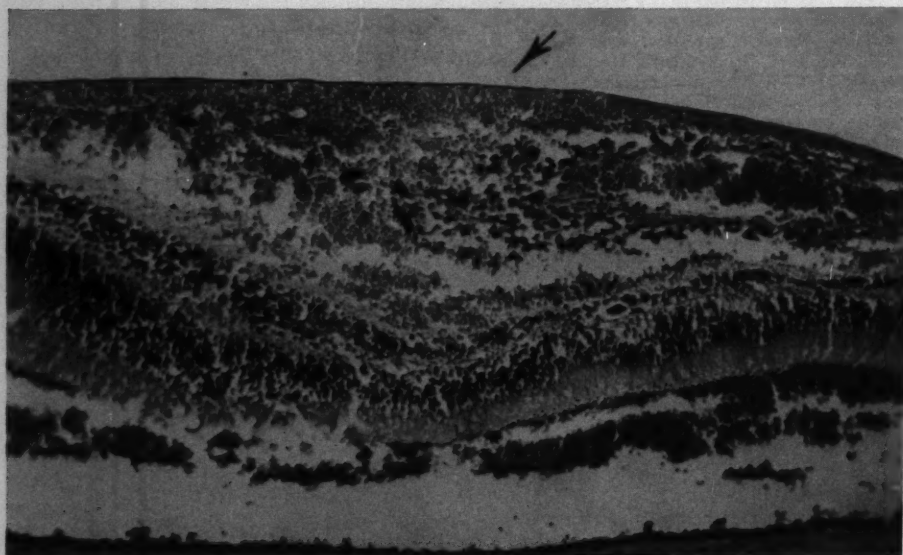


Fig. 3 (Liddicoat, Wolter and Wilkinson). Section through an intermediate part of the metastasis in the retina. Tumor cells (arrow), blood vessels and hemorrhage are visible in the inner retinal layers. The outer retinal layers are not involved. There is some retroretinal exudate. (Hematoxylin-eosin, photomicrograph.)

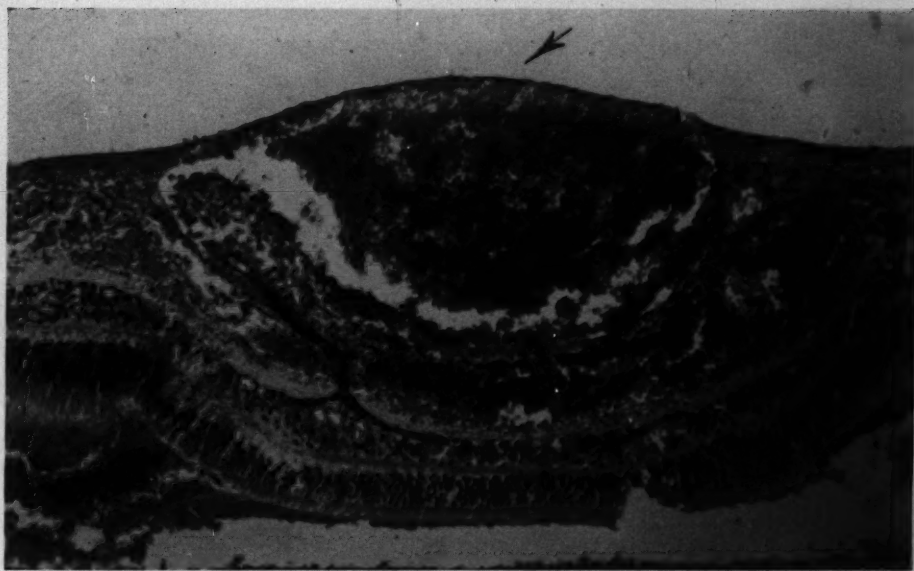


Fig. 4 (Liddicoat, Wolter and Wilkinson). Section through the center of the retinal metastasis. A large hemorrhage is seen on the inner surface of the lesion (arrow). The tumor cells and a branching blood vessel are seen beneath the hemorrhage. The outer retina is not involved. (Hematoxylin-eosin, photomicrograph.)

membrane and no extension of the lesion into the outer retinal layers were seen (figs. 2 to 4). The thickened inner layers in the area of the lesion showed complete destruction of all retinal elements. These were replaced by neoplasm, hemorrhage and rather large thin-walled blood vessels.

The elements of the neoplasm represented dense groups of pale-staining cells of a somewhat epithelioid character (figs. 5 to 7). They had a well-developed protoplasm and rather large nuclei of irregular shape and size. No mitoses were seen. Peculiar rod-shaped pigment granules were found all through the neoplasm (fig. 6). Large accumulations of these granules were seen on the wall of all blood vessels in the area of the tumor (figs. 5 to 7). The granules looked dark brown after hematoxylin-eosin stain. No other stains were done since all sections through the tumor had been stained with hematoxylin-eosin.

A large central and some smaller marginal

areas of the lesion were composed of fresh hemorrhage (figs. 2 to 4). A small amount of eosinophilic exudate was seen in the retro-retinal space (figs. 2 to 4). The choroid beneath the lesion and the vitreous on the lesion were completely normal.

Thanks to the co-operation of Dr. M. F. Vido'i of the St. Vincent's Hospital, Toledo, Ohio, we were able to study a histologic slide of the hip biopsy which was taken in the summer of 1957. This showed a typical malignant melanoblastoma as it is known to originate in the skin. It was not the primary tumor but also a metastasis and it can be said that this was the same neoplasm as that found in the retina.* No pigment granules were seen in the neoplasm in this slide.

The pathologic diagnosis of this case was retinal metastasis of a malignant melanoblastoma of the skin.

* We would like to thank Dr. R. C. Hendrix of the Department of Pathology of this Medical Center for his help in classifying the neoplasm.

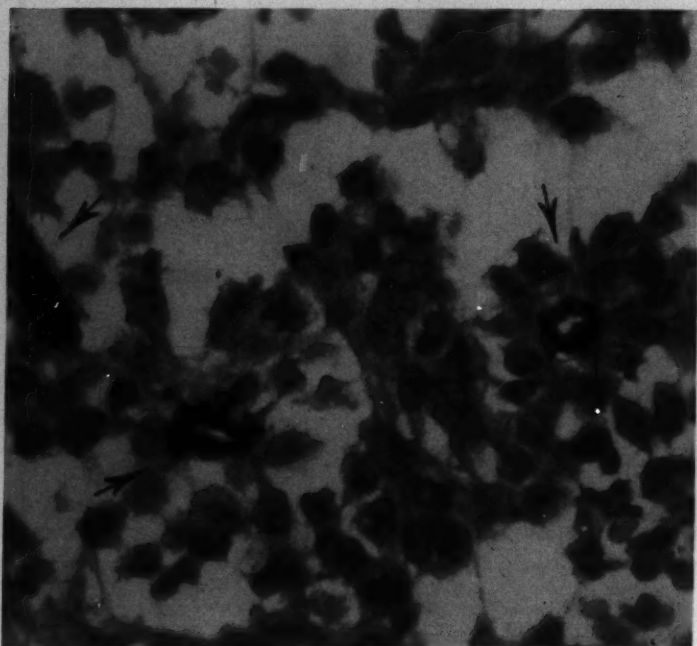


Fig. 5 (Liddicoat, Wolter and Wilkinson). High-power view of the neoplasm in the retina. The blood vessels in it show dense pigment sheathing (arrows). (Hematoxylin-eosin, photomicrograph.)

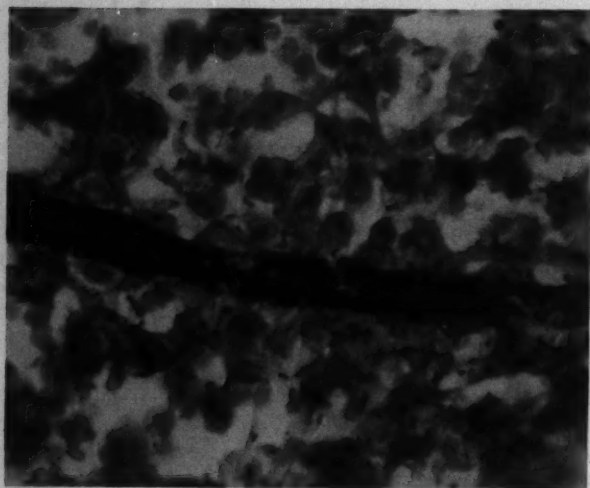
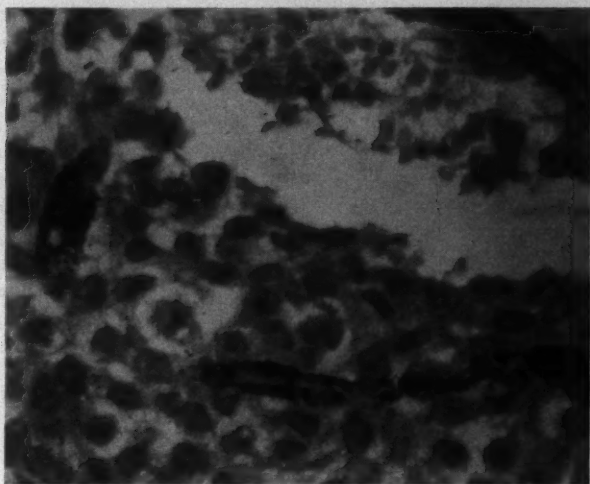


Fig. 6 (Liddicoat, Wolter and Wilkinson). High-power view of another area of the neoplasm in the retina. Rod-shaped pigment granules are seen in the tumor cells. The same granules are deposited around a blood vessel. (Hematoxylin-eosin, photomicrograph.)

Fig. 7 (Liddicoat, Wolter and Wilkinson). High-power view of an area of the retinal neoplasm with blood vessels (below) and of retinal hemorrhage (above) as seen in this case of retinal metastasis. (Hematoxylin-eosin, photomicrograph.)



COMMENT

This is the first reported case in which a retinal metastasis not involving the disc was seen and diagnosed ante mortem. It is the eighth reported case of retinal metastasis.

SUMMARY

A case of metastatic malignant melanoma of the retina is reported and the literature of retinal metastases is reviewed.

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LOW-VISION CLINICS: A REPORT

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This report represents data on 841 cases collected from seven low-vision clinics in New York, Massachusetts, Maryland, North Carolina, and Ohio. The purpose of this report was to collect data on the low-vision clinics which are in progress at present and to analyze the data objectively with reference

to the type of patient, his particular eye pathology, his visual acuity and visual need, and how well, if at all, this visual acuity can be aided with either the usual refraction devices or more specialized visual aids.

Preliminary to gathering data, a questionnaire consisting of 54 questions was designed

CHART 1
INDUSTRIAL HOME FOR THE BLIND

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	15	5.0
Lens	34	10.6
Vitreous	3	1.0
Nerve	45	15.0
Retina	162	54.0
Choroid	13	4.5
Suppression	1	0.4
Optic pathway	2	0.5
Refraction	27	9.0
TOTAL	302	100.0
II. Diagnosis		
Albinism	10	3.6
Retinitis pigmentosa	19	6.6
Cataract	30	10.0
Retrolental fibroplasia	5	1.9
Congenital malformation	11	3.9
Trauma	4	1.6
Chorioretinitis	32	10.0
Glaucoma	28	9.6
Diabetic retinopathy	16	5.6
Optic atrophy	43	14.6
Macular degeneration	47	15.9
Congenital nystagmus	2	0.6
Myopia	25	8.6
Uveitis	5	1.6
Keratoconus	1	0.3
*Others	24	5.6
TOTAL	302	100.0

* Cornea—
 dystrophy (4)
 scar (4)
 interstitial keratitis (3)
 leukoma (3)
 opacity (1)

* Retina—detachment (8)

* Suppression—with hyperopia (1)

so that the individual history of each patient could be analyzed in rather minute detail. Although it was hoped that all 54 categories could be answered for each case, it was realized that the method of data collection in each individual clinic would vary. Since some of the categories were felt to be of primary importance in properly analyzing the information collected, if a particular history did not yield this minimum amount of information it could not or was not used in this study. This does not mean that the particular clinic failed to have a proper history but only that for our purposes of analysis there were

certain points of history that were absolutely essential. Thus, for each clinic, histories were submitted by that clinic at its discretion and then reviewed by a worker who used only those histories submitted to him which he felt gave enough information to be used in the analysis in which we were interested.

The choice of histories submitted was entirely up to the discretion of the individual clinic. However, the choice of histories that were used in this study was entirely up to the discretion of the particular worker reviewing them. After the data was collected and sorted, it was tabulated on punch cards and submitted for statistical analysis.

INDUSTRIAL HOME FOR THE BLIND

There were 302 cases obtained from the Industrial Home for the Blind. Chart 1 presents the cause of poor vision and the diagnosis by number of cases and percent of total cases. In analyzing the *length of blindness*, the mean and median value fell in the over-20-years group. The ratio of male to female in this group was 70 to 30. Interestingly enough in the group of optic atrophy, the incidence of males with the disease exceeded that of females with the disease by some 11 percent which is statistically significant. There was insufficient data on the job held by the individual patient before and after his blindness but there appeared to be several men in this group who did seek jobs for the blind after they had come to the Industrial Home for the Blind.

The *primary visual need* was overwhelmingly for close vision especially in reading, 80 percent of the patients listing this as their greatest need. The *rate of onset of poor vision* was rather slow, 70 percent of the patients having a rate of onset in excess of 10 years.

There was insufficient data on the *visual efficiency* of this patient group and 163 of the 302 patients or 54 percent were not wearing any refractive correction when first seen by the clinic. It is possible that a certain number of these patients may have been wearing

TABLE 1
FOR DISTANCE VISION WITH AID OR REFRACTION
VISION 20/100 OR BETTER

	No. Cases	No. Fitted	% Fitted	No. Success	% Success
Industrial Home	302	161	53	91	56
Lighthouse	224	98	43	60	61
Volk	109	11	10	8	—*
Maryland Workshop	87	76	87	45	59

* Analysis deferred since number fitted is small.

a refractive correction but this data was not supplied. Among the special aids tried in the preliminary examinations, 242 of 302 patients or 80 percent were tried on telescopic visual aids, 33 or 11 percent were tried on microscopic aids, and 25 or eight percent on spectacles or bifocals. (It may be pointed out that almost all patients are routinely tried on telescopes in the preliminary examination, thus accounting for the high incidence of telescopic lens trial.)

Of the 302 patients so examined, 144 or 47 percent received no special aid or new refractive correction, presumably because such aid or correction would not improve visual acuity. Of the remaining, 17 percent received $\times 2.2$ magnifiers and 80 percent received high adds.

When the vision without glasses is compared with the vision with glasses for distance, it is interesting that 95 of 148 patients, or 60 percent have an improvement of vision with the usual refractive correction. Using 20/100 vision or better as a criterion for successful fitting of a low visual aid or a new refraction for distance vision, a visual acuity of 20/100 or better was obtained in 56 per-

cent of the remaining 161 patients. For near vision a criterion of visual acuity J1 to J5 at five inches or better was used. Sixty-one percent of the 173 patients fitted with a visual aid or given a new refraction were able to obtain this level of visual acuity.

Tables 1 and 2 review the data on visual acuity obtained with aids for new refractions for near and distance vision. Table 3 analyzes the number of cases in each group found suitable to be tried on a visual aid with each pathologic condition. In addition, it indicates the number of patients able to obtain the level of visual acuity (J1 to J5 at five inches or better). In general, about 55 percent of the cases in each group were found suitable to attempt a trial with a visual aid. Of those tried, between 55 and 60 percent of those fitted obtained the level of visual acuity already mentioned. It is necessary in analyzing this type of data to note the total number of cases in the group to be analyzed, the number of cases in this group that are tried on visual aids and then the percentage of those tried on visual aids that manage to obtain the particular level of visual acuity—stated (table 3).

TABLE 2
FOR NEAR VISION WITH AID
VISION: J1 TO J5 AT FIVE INCHES OR BETTER

	No. Cases	No. Fitted	% Fitted	No. Success	% Success
Industrial Home	302	173	57	106	61
Lighthouse	224	180	80	159	90
Volk	109	84	76	75	89
Maryland Workshop	87	74	85	45	60
Massachusetts Eye and Ear	56	40	71	31	78
Tillett	40	34	85	29	85

TABLE 3
INDUSTRIAL HOME

	Vision: J1 to J5			Vision: 20/100 or Better		
	*	†	‡	*	†	‡
1 Albinism	5/	7/	10/	5/	8/	10/
2 Retinitis pigmentosa	4/	8/	19/	6/	10/	19/
3 Cataract	14/	19/	30/	5/	19/	30/
4 Retrolental fibroplasia	1/	3/	5/	2/	3/	5/
5 Congenital malformation	6/	9/	11/	2/	6/	11/
6 Trauma	1/	2/	4/	0/	2/	4/
7 Chorioretinitis	12/	19/	32/	12/	18/	32/
8 Glaucoma	7/	16/	28/	10/	13/	28/
9 Diabetic retinopathy	6/	10/	16/	6/	8/	16/
10 Optic atrophy	9/	23/	43/	6/	13/	43/
11 Macular degeneration	17/	25/	47/	12/	22/	47/
13 Congenital nystagmus	0/	0/	2/	2/	2/	2/
14 Myopia	14/	16/	25/	14/	19/	25/
15 Uveitis	1/	2/	5/	0/	1/	5/
16 Keratoconus	0/	0/	1/	1/	1/	1/
Other	9/	14/	24/	8/	16/	24/
TOTAL	106/	173/	302/	91/	161/	302/

* Number of cases with vision stated above.

† Number of cases tried with visual aid.

‡ Total cases in group.

NEW YORK ASSOCIATION FOR THE BLIND
(THE LIGHTHOUSE)

The second clinic analyzed was that of the New York Association for the Blind (The Lighthouse). Chart 2 indicates the cause of poor vision and the diagnosis. The mean and median values for *length of blindness* fell in the over-20-years group. The ratio of male to female was 63 to 37. The males outnumbered the females in the optic atrophy group by 14 to six percent, whereas in the cataract group the females outnumbered the males 17 to nine percent. Following blindness, many males took jobs for the blind in this group. Many more became students. The professional, semiskilled and unskilled group appeared to retain the same work before and after blindness.

Ninety percent listed reading as their *primary visual need*. The mean and median value for the *rate of onset of poor vision* was over 10 years. Ninety-seven percent were able to travel outside without a companion.

Of the glasses used by patients first coming to the Lighthouse, many wore spheres but very few patients were wearing a cylin-

der in their refractive correction. Of the special aids tried, 60 percent consisted of spectacles or bifocals and 20 percent telescopic or microscopic lenses. In 60 percent no special visual aid was prescribed although many of these patients received a new refraction. Of the remaining patients, 37 percent received $\times 2.2$ magnifiers and in 60 percent high adds were prescribed.

In the 224 cases, 56 percent had an improvement of their visual acuity with a new

CHART 2
NEW YORK ASSOCIATION FOR THE BLIND
(THE LIGHTHOUSE)

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	5	2.2
Lens	28	12.5
Vitreous	—	—
Nerve	41	18.2
Retina	94	42.0
Choroid	10	4.4
Suppression	4	1.8
Optic pathway	—	—
Refraction	40	18.0
Other	—	—
No history	2	0.9
TOTAL	224	100.0
II. Diagnosis		
Albinism	17	7.5
Retinitis pigmentosa	13	5.8
Cataract	25	11.3
Congenital malformation	6	2.8
Trauma	1	0.5
Chorioretinitis	11	4.9
Glaucoma	17	7.5
Diabetic retinopathy	8	3.7
Optic atrophy	25	11.3
Macular degeneration	31	13.9
Congenital nystagmus	2	0.9
Myopia	37	16.5
Uveitis	2	0.9
*Other	29	13.0
TOTAL	224	100.0

* Cornea { opacity (3)
leukoma (1)
keratitis (1)
microcornea (1)

* Retina { detachment (8)
hemorrhage (4)
degeneration (2)
fold (1)

* Refraction—hyperopia (2)
* Suppression—strabismus (4)
* Cataract—cerulean (1)
* Chorioretinitis (1)

refraction. This visual acuity was an improvement in distance vision and the improvement is in terms of any increase in visual acuity that could be measured by the reading chart used. Thus, an improvement from 20/200 to 20/100 would represent an improvement just as would a change from 5/200 to 20/200 vision.

Of the remaining 89 patients, 56 merely received a new refraction, often with the utilization of high spherical add. Forty-three percent of the total group received a new refraction or special aid and of these

CHART 3
MARYLAND WORKSHOP FOR THE BLIND

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	6	6.8
Lens	15	17.2
Vitreous	4	4.5
Nerve	10	11.5
Retina	40	46.0
Choroid	1	1.2
Suppression	1	1.2
Optic pathway	5	5.8
Refraction	5	5.8
TOTAL	87	100.0
II. Diagnosis		
Retinitis pigmentosa	5	5.8
Cataract	12	13.8
Congenital malformation	2	2.3
Trauma	3	3.5
Chorioretinitis	6	6.8
Glaucoma	5	5.8
Diabetic retinopathy	4	4.5
Optic atrophy	6	6.8
Macular degeneration	18	20.8
Congenital nystagmus	4	4.5
Myopia	5	5.8
Uveitis	1	1.2
*Other	16	18.4
TOTAL	87	100.0

- * Cornea { scar (1)
leukoma (1)
opacity (1)
ulceration (1)
vascularization (1)
- * Vitreous—hemorrhage (4)
- * Nerve { optic neuritis (1)
Leber's disease (1)
- * Retina { detachment (3)
hemorrhage (1)
- * Suppression—strabismus (1)

TABLE 4
LIGHTHOUSE

	Vision: J1 to J5 or Better			Vision: 20/100 or Better		
	*	†	‡	*	†	‡
1 Albinism	11/	12/17		4/16/	17	
2 Retinitis pigmentosa	8/	10/13		2/	3/	13
3 Cataract	18/	20/25		6/11/	25	
4 Retrolental fibroplasia						
5 Congenital malformation	5/	5/	6	2/	4/	6
6 Trauma	1/	1/	1	0/	1/	1
7 Chorioretinitis	8/	11/11		2/	5/	11
8 Glaucoma	15/	16/17		4/	7/	17
9 Diabetic retinopathy	6/	6/	8	3/	3/	8
10 Optic atrophy	15/	21/25		5/	5/	25
11 Macular degeneration	22/	22/31		5/	7/	31
13 Congenital nystagmus	1/	2/	2	2/	2/	2
14 Myopia	26/	29/37		18/24/	37	
15 Uveitis	2/	2/	2	0/	0/	2
16 Keratoconus						
Other	21/	23/29		7/10/	29	
TOTAL	159/	180/22		60/98/	224	

* Number of cases with vision stated above.

† Number of cases tried with visual aid.

‡ Total cases in group.

89 cases, 60 percent had a visual acuity of 20/100 or better for distance, some of the myopes in the group being corrected to 20/30 and 20/40 vision. Twenty percent of the total group were not fitted with an aid for reading, and of the remaining 180 cases, 88 percent obtained visual acuity of J1 to J5 at five inches or better. Tables 1 and 2 review the last two categories of data and Table 4 presents a break-down according to disease in the group from the Lighthouse.

MARYLAND WORKSHOP FOR THE BLIND

The Maryland Workshop for the Blind is analyzed as to cause of poor vision and diagnosis in Chart 3. The median length of blindness fell in the 15-to-20-year group. The ratio of male to female was 56 to 44. There were no cases of retinitis pigmentosa or trauma among females. Job data was insufficient and 73 percent listed reading as their primary visual need. As to rate of onset of poor vision, 55 percent exceeded 10 years in time while 45 percent were unknown. Eighty-five percent of this group were able to travel outside without a companion and most of the

TABLE 5
MARYLAND WORKSHOP

	Vision: J1 to J5 Near	Vision: 20/100 or Better
1 Albinism	* † †	* † †
2 Retinitis pigmentosa	1/ 4/ 5	1/ 4/ 5
3 Cataract	8/12/12	6/11/12
4 Retrolental fibroplasia	—	—
5 Congenital malformation	2/ 2/ 2	2/ 2/ 2
6 Trauma	1/ 3/ 3	3/ 3/ 3
7 Chorioretinitis	3/ 5/ 7	4/ 6/ 7
8 Glaucoma	3/ 4/ 4	1/ 3/ 4
9 Diabetic retinopathy	3/ 4/ 4	3/ 4/ 4
10 Optic atrophy	2/ 5/ 6	3/ 6/ 6
11 Macular degeneration	9/14/18	9/14/18
13 Congenital nystagmus	2/ 3/ 4	4/ 4/ 4
14 Myopia	2/ 3/ 5	4/ 5/ 5
15 Uveitis	1/ 1/ 1	0/ 1/ 1
16 Keratoconus	—	—
Other	8/14/16	5/13/16
TOTAL	45/74/87	45/76/87

* Number of cases with vision stated above.

† Number of cases tried with visual aid.

‡ Total cases in group.

patients were wearing a sphere without cylindrical correction. Eighty percent of the patients were tried on telescopes, 11 percent on spectacles, caps and bifocals, five percent on microscopic lenses and three percent on Japanese sport glasses. As to aids prescribed, 75 percent received $\times 2.2$ magnifiers, eight percent high adds, and 11 percent were not given a correction. Of the 77 cases receiving a low visual aid, 75 percent received $\times 2.2$ magnifiers and 22 percent received a new refractive correction. Of the 76 cases receiving a new refractive correction or a special visual aid, 56 percent obtained a visual acuity of 20/100 or better. Sixty percent of the 74 cases receiving a low visual aid for near vision obtained a visual acuity of J1 to J5 at five inches or better. Again Table 1 and Table 2 review the last two categories and Table 5 presents a breakdown of the visual acuity results as to individual pathologic diagnoses.

MASSACHUSETTS EYE AND EAR INFIRMARY

Chart 4 lists the causes of poor vision and diagnosis for the Massachusetts Eye and Ear

Infirmary. The median length of blindness fell in the 8-to-20-year group. The ratio of male to female was 63 to 37. There was insufficient data on jobs. Ninety percent listed reading or close work as their primary visual need. Seventy percent had a rate of onset of poor vision in excess of 10 years. All of the patients were able to travel outside without a companion. Most cases were prescribed spheres without cylindrical correction. Among the special aids tried were telescopic lenses in 62 percent, microscopics in nine percent, hand magnifiers in four percent and 25 percent were tried with spectacles. In actuality, 43 percent received no visual aids, 56 percent of the remaining 32 cases received $\times 2.2$ telescopes and 44 percent received high adds. In 52 percent of the cases there was a visual improvement when a new refraction was given at the initial visit. Of 36 cases for which data was available, 28 percent re-

CHART 4
MASSACHUSETTS EYE AND EAR INFIRMARY

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	1	1.8
Lens	11	19.6
Vitreous	1	1.8
Nerve	8	14.3
Retina	29	51.7
Choroid	1	1.8
Suppression	—	—
Optic pathway	—	—
Refraction	5	9
TOTAL	56	100.0
II. Diagnosis		
Albinism	1	1.8
Retinitis pigmentosa	3	5.3
Cataract	10	17.9
Congenital malformation	2	3.5
Chorioretinitis	3	5.3
Glaucoma	7	12.6
Diabetic retinopathy	2	3.5
Optic atrophy	1	1.8
Macular degeneration	14	25.0
Myopia	4	7.1
Uveitis	1	1.8
Keratoconus	1	1.8
*Others	7	12.6
TOTAL	56	100.0

* Retina—detachment (1)

* Unknown (6)

ceived $\times 2.2$ telescopes and 72 percent received high adds. This represents an increase in visual acuity caused by the low visual aid above and beyond that visual acuity that could be obtained by usual refraction only. Forty-three percent of the cases fitted obtained a visual acuity of 20/100 and 78 percent obtained a visual acuity of J1 to J5 at five inches or more. Table 2 reviews this last category. This group of cases represents too small a group to be broken down as to individual disease entity. Therefore, no further analysis was performed.

CLINIC OF DR. CHARLES TILLET

Chart 5 lists the cause of poor vision and diagnosis in the clinic population of Dr. Charles Tillett. Approximately 80 percent of the patients had a length of blindness in excess of 20 years. The male to female ratio was 45 to 55. There was insufficient data on job information, 90 percent of the cases list-

CHART 5
CLINIC OF DR. TILLET

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	2	5.0
Lens	3	7.5
Vitreous	—	—
Nerve	3	7.5
Retina	21	52.5
Choroid	1	2.5
Suppression	2	5.0
Optic pathway	—	—
Refraction	7	17.5
Other	1	2.5
TOTAL	40	100.0
II. Diagnosis		
Albinism	5	12.5
Retinitis pigmentosa	6	15.0
Cataract	3	7.5
Congenital malformation	5	12.5
Chorioretinitis	7	17.5
Glaucoma	1	2.5
Diabetic retinopathy	1	2.5
Optic atrophy	2	5.0
Macular degeneration	3	7.5
Congenital nystagmus	1	2.5
Myopia	5	12.5
*Other	1	2.5
TOTAL	40	100.0

* Corneal leukoma

CHART 6
WESTERN RESERVE CLINIC

	Number of Cases
I. Cause of Poor Vision	
Cornea	2
Lens	3
Vitreous	—
Nerve	4
Retina	14
TOTAL	23
II. Diagnosis	
Cataract	4
Chorioretinitis	1
Glaucoma	1
Diabetic retinopathy	5
Optic atrophy	4
Macular degeneration	7
Unknown	1
TOTAL	23

ing reading as their primary visual need. There was insufficient data on the rate of onset of poor vision; however, all listed travel outside without a companion. Most of the patients wore spheres without cylindrical corrections. Among the special aids tried were telescopic or microscopic lenses in 50 percent, German sport glasses in 28 percent, spectacles or bifocals in the remaining 18 percent. Seventeen of the 40 cases or 42 percent received no visual aid correction. Of the remaining 23 cases 21 patients received a $\times 2.2$ correction, one patient received a $\times 1.7$ correction and one patient received a high add. Thirty-six percent of the total group were improved with their new refractive correction and after their correction was in place, 77 percent of those patients so improved were given $\times 2.2$ magnifiers while 18 percent were given high adds for further correction. Sixty percent of the patients corrected obtained a visual acuity of 20/100 or better while 85 percent obtained a visual acuity of J1 to J5 or better. Table 2 summarizes this last point.

THE CLINIC AT WESTERN RESERVE UNIVERSITY

Chart 6 lists the cause of poor vision and diagnosis in the Western Reserve Clinic

CHART 7
DR. DAVID VOLK—PRIVATE PRACTICE

	Number of Cases	% Cases
I. Cause of Poor Vision		
Cornea	2	1.8
Lens	17	15.2
Vitreous	2	1.8
Nerve	10	10.0
Retina	61	55.3
Choroid	4	3.7
Suppression	—	—
Optic pathways	—	—
Refractive errors	6	5.6
Other	4	3.8
No history	3	2.8
TOTAL	109	100.0
II. Diagnosis		
Albinism	2	1.8
Retinitis pigmentosa	2	1.8
Cataract	23	20.3
Retrolental fibroplasia	2	1.9
Congenital malformation	1	0.9
Trauma	1	0.9
Chorioretinitis	10	9.8
Glaucoma	3	2.8
Diabetic retinopathy	7	6.5
Optic atrophy	7	6.5
Macular degeneration	33	30.0
Congenital nystagmus	5	4.7
Myopia	9	8.4
Uveitis	1	0.9
Keratoconus	1	0.9
*Others	2	1.9
TOTAL	109	100.0

* Cornea—dystrophy (1)

* Retina—retinopathy secondary to toxemia of pregnancy (1)

group. Due to the small number of cases, only some of the categories in which data was gathered will be mentioned for only in these groups was the data of significant value. The male to female ratio was nine to 14. Thirteen of the 23 patients were wearing a sphere without a cylinder, whereas eight of the 23 wore spheres with cylindrical correction at first examination. Among the special aids tried 95 percent were tried with aspherical lenses, five percent with telescopes. Forty percent of the group received no visual aid while 60 percent received a spherical correction for near. Of those cases receiving aspherical adds, 60 percent obtained a visual acuity of J1 to J5 or better.

DR. DAVID VOLK (PRIVATE PRACTICE)

Chart 7 summarizes the cause of poor vision and diagnoses according to disease in the private practice of Dr. David Volk. The distribution of patients in his clinic were male to females 55 to 45. There was insufficient data on job history, on visual need, on rate of onset of poor vision and visual efficiency. Eighty-eight patients were wearing a sphere while 44 had both a sphere and cylindrical correction. In the group of 109 patients, 88 percent were tried with aspherical correction, two percent with a telescopic correction and seven percent were given no trial with a special aid. There was insufficient data comparing the distance vision without glasses versus the distance vision with glasses. Of the 34 patients receiving an aspherical lens for reading, 75 to 89 percent obtained a visual acuity of J1 to J5 or better. Tables 1 and 2 summarize these last two categories and Table 6 presents a breakdown as to particular disease entity and visual acuity so obtained.

TABLE 6
DR. DAVID VOLK

	Vision: J1 to J5 or Better			Vision: 20/100 or Better		
	* † ‡	* † ‡		* † ‡	* † ‡	
1 Albinism	2/ 2/ 2	0/ 0/ 2		0/ 0/ 2		
2 Retinitis pigmentosa	1/ 1/ 2	0/ 0/ 2		0/ 0/ 2		
3 Cataract	18/19/ 23	3/ 6/ 23		3/ 6/ 23		
4 Retrolental fibroplasia	1/ 1/ 2	0/ 0/ 2		0/ 0/ 2		
5 Congenital malformation	1/ 1/ 1	0/ 0/ 1		0/ 0/ 1		
6 Trauma	1/ 1/ 1	0/ 0/ 1		0/ 0/ 1		
7 Chorioretinitis	5/ 7/ 10	0/ 0/ 10		0/ 0/ 10		
8 Glaucoma	1/ 1/ 3	1/ 1/ 3		1/ 1/ 3		
9 Diabetic retinopathy	5/ 5/ 7	0/ 0/ 7		0/ 0/ 7		
10 Optic atrophy	5/ 6/ 7	0/ 0/ 7		0/ 0/ 7		
11 Macular degeneration	26/29/ 33	1/ 1/ 33		1/ 1/ 33		
13 Congenital nystagmus	3/ 4/ 5	0/ 0/ 5		0/ 0/ 5		
14 Myopia	5/ 6/ 9	1/ 1/ 9		1/ 1/ 9		
15 Uveitis	0/ 0/ 1	1/ 1/ 1		1/ 1/ 1		
16 Keratoconus	0/ 0/ 1	1/ 1/ 1		1/ 1/ 1		
Other	1/ 1/ 2	0/ 0/ 2		0/ 0/ 2		
TOTAL	75/84/109	8/11/109				

* Number of cases with vision stated above.

† Number of cases tried with visual aid.

‡ Total cases in group.

DISCUSSION

In discussing the data presented one may initially treat the group of 841 cases as if they came from the same clinic. It is true that all the patients have a common denominator, that is, they were all seeking aid at low vision clinics, but there are differences in the specific population makeup of each clinic considered. Let us first analyze some generalities that can be made from the data already given.

In general the median length of blindness was from eight to 20 years. This may be attributed either to the little interest shown in low vision problems until relatively recent times or to the fact that patients are not being referred to ophthalmologists or eye clinics early in the disease process. There is a predominance of males in the groups studied which may be due to the fact that males seek help because they must work and support a family.

The majority of patients list reading as their primary visual need. In addition, the overwhelming majority were able to travel outside without the aid of a companion. These two facts, therefore, supplement each other, that is, given a low visual acuity it is far easier to make an adjustment in terms of distance vision than in terms of near vision.

The rate of onset of poor vision was in excess of 10 years. This suggests that the patient in general has a long time to adjust to a gradually progressing visual disability. Also there appeared to be few cases of loss of vision due to trauma or other sudden occurrences.

The majority of patients presenting themselves to a low-vision clinic are wearing spectacles containing in general only a spherical correction. This may be due to the difficulty of refracting these patients; or perhaps the refractionist may feel that in patients with low visual acuity, it is not important to correct the refractive error properly. A large number of visual aids are tried in all the clinics

studied but each clinic seems to have a particular visual aid which it favors. For example, the Maryland Workshop prescribed $\times 2.2$ telescopic magnifiers in 75 percent of the cases; the Lighthouse prescribed high adds in 60 percent of the cases; and Dr. Volk employs the aspherical lens in most of his visual aid prescriptions. It is interesting that vision in a large number of cases coming to a low-vision clinic can be materially improved for distance by the proper prescription, as many as 60 percent could be improved in this manner. (Again improvement signifies any increase of visual acuity that can be measured by the reading chart used. Thus, improvement of visual acuity from 20/200 to 20/100 would be a significant improvement as well as change of visual acuity from 5/200 to 20/200.)

At first glance, Table 2 would seem to indicate that the Industrial Home for the Blind and the Maryland Workshop had less success in correcting low visual acuity for near than Dr. Volk's private practice or the Lighthouse. However, two points must be taken into account when one attempts to compare one clinic with another. One must ask oneself whether the patients presenting at each clinic are identical in pathologic alterations of the eye and whether any selective process eliminates from the group going to the low vision clinic those cases which would be considered particularly poor material for improvement of visual acuity.

Table 7 arbitrarily creates two groups. Group A is a favorable group and consists of those disease entities that seem more amenable to improvement of visual acuity with special visual aids. This group would include albinism, congenital nystagmus, macular degeneration, cataracts, and myopia. Group B, or the unfavorable group, consists of those disease entities less amenable to correction and would include retinal detachment, retinitis pigmentosa, glaucoma, diabetic retinopathy, and optic atrophy.

If one analyzes the ratio of Group A to

TABLE 7
COMPARISON OF GROUPS ACCORDING TO
POSSIBILITY OF VISUAL IMPROVEMENT

Favorable Group A	Albinism Congenital nystagmus Macular degeneration Cataract Myopia
Unfavorable Group B	Retinal detachment Retinitis pigmentosa Glaucoma Diabetic retinopathy Optic atrophy
Volk	A 65% B 28%
Lighthouse	A 56% B 35%
Massachusetts Eye and Ear	A 52% B 30%
Maryland Workshop	A 46% B 35%
Industrial Home for the Blind	A 40% B 50%

Group B for each of five clinics, one can immediately note that, whereas Dr. Volk's private practice has a preponderance of favorable disease entities, namely 65 percent, the Industrial Home for the Blind has a minimum number of favorable cases, namely 40 percent. Consequently, when one compares one clinic with another it is important to know the makeup of the particular disease entities of the clinic population.

This particular point has been followed up in four clinics—the Industrial Home, The Lighthouse, Maryland Workshop and Dr. Volk's practice. In Tables 3, 4, 5, and 6 there is presented for each clinical disease entity the total number of patients, the number of patients in whom a visual aid was tried and the number of patients successfully obtaining the visual acuity noted. One can gather from these four tables whether the particular patient group was or was not relatively amenable to treatment with a visual aid. Thus, if a small percentage of the total group was finally tried with visual aids, one could infer that the initial group had so many poor candidates that it was very difficult even to find

those who might succeed with a visual aid. Furthermore, if the number of visual aid improvements was very small as compared to the number in whom the visual aid was tried, again one could infer that the original group indeed presented very few likely candidates for visual improvement.

As an example if one looks at item II (macular degeneration) in Chart 1, the Industrial Home for the Blind had 47 cases in this group of which only 25 or about 50 percent were amenable to being fitted with a visual aid. Of those 25 who were fitted only 17 obtained the visual acuity of J1 to J5 or better. When one compares the same item (macular degeneration) in Dr. Volk's series, there are 33 cases, twenty-nine of which could be fitted. Of those 29 cases 26 were successfully fitted by the criteria used. Thus, Dr. Volk presumably began with a much more favorable group since he was able to attempt to fit visual aids in a higher percentage of cases.

It is also realized that an institution such as the Industrial Home will see any patient referred to it from any source without any previous screening, whereas other clinics such as the Lighthouse do receive referrals from private practitioners and there is an element of screening; cases which are obviously hopeless do not reach the Lighthouse as often they might the Industrial Home for the Blind. This again would produce somewhat of a bias in the population makeup which is thus reflected in the over-all data.

Because of these difficulties of trying to reconcile the different clinics with each other, only a qualitative comparison can be made. In general, it appears that despite different clinics favoring different visual aids, the percent success in obtaining the visual criteria as used in this report seems to be comparable in all the clinics analyzed.

CONCLUSIONS

Eight hundred forty-one cases from seven different low vision clinics in the country were analyzed as outlined in the paper. The

group from each clinic represented a random sample from the files of that clinic, the only bias being that these patients had come to the particular clinic for attempted fitting of a visual aid in the case of low visual acuity. All information derived from the data has been obtained separately for near and distant vision with and without refractive correction; also indicated is the aid which was prescribed and the level of visual acuity so obtained. These data were broken down into each individual disease group. It appears that

the most valuable aid to vision is the proper correction of the refractive error. This accounted for the largest improvement in visual acuity. Further improvement in reading and close work was obtained with the use of special low-vision aids. In the case of the seven clinics analyzed the aid varied from clinic to clinic but in general the level of visual acuity was comparable from one clinic to the other.

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OPTOKINETIC NYSTAGMUS: A TEST FOR PARIETAL LOBE LESIONS*

A STUDY OF 31 ANATOMICALLY VERIFIED CASES

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Optokinetic nystagmus is an induced jerky to-and-fro involuntary oscillation of the eyes. It is symmetric or nearly so in the normal individual. A defective response to one side assumes significance if an intact response is elicited on rotating targets to the other side. Such a finding has been termed a "positive O.N. sign" (optokinetic nystagmus sign).¹ The normal or symmetric response is a "negative O.N. sign."

Bárány² was the first to note that some patients with homonymous hemianopia had a defective optokinetic nystagmus response when targets were rotated away from the defective field, and yet intact to the opposite direction. He at first attributed this simply to inability to see the targets in the former instance, that is, an *afferent* visual lesion. However, Brunner,³ Ohm,⁴ and Fox and

Holmes⁵ found that, whereas this was true in certain cases with homonymous field defects, in others with equally dense and absolute homonymous hemianopias the optokinetic response was symmetric to both sides. This immediately revealed that the positive optokinetic nystagmus sign was not due solely to an afferent lesion.

Cords⁶ explanation for the asymmetric response was that there must be an *efferent* optomotor lesion to account for the phenomenon, and that the most likely site was in the internal and external sagittal strata of the middle and posterior one third of the optic radiations, or deep in the parietal lobe. Kestenbaum¹ analyzed a series of 59 cases of homonymous hemianopia in which the lesions had been localized by autopsy, surgery, or by roentgenogram. The number of cases in each of these three subdivisions was not stipulated. He considered a negative optokinetic nystagmus sign as 100 percent reliable in excluding a parietal lobe origin for a homonymous hemianopia. Although opin-

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TABLE 1
OPTOKINETIC NYSTAGMUS IN THE AUTOPSY PROVED CASES

Case	Age	Sex	Vision	Fields*	O.N. Sign†	Symptoms and Course	Anatomic Findings	Comment
1	32	F	Normal	Normal	Negative at first; later positive.	Uncinate fits and memory defect, 10 mo. later. RHH. Right parietal lobe astrocytoma 47 mo. later, recurrence. Macular splitting RHH, with positive O.N. sign	Glioblastoma multiforme, left parietal lobe. Necrotic center, left parietal nucleus, thalamus, internal capsule on left. No lesion in right hemisphere. Left uncus herniated; midbrain shifted to right. Brain stem normal	At the time the glioma presumably infiltrated the uncus, the left parietal optokinetic response was symmetrical. Later with involvement of parietal (and other) lobes, a positive O.N. sign was present
2	70	F	Good	RHH	Positive	Dysphasia and seizures 5 months. Craniotomy disclosed meningioma, parieto-temporo-occipital craniotomy, which revealed a necrotic glioma	Glioblastoma multiforme. On section, tumor involved left parietal and occipital ganglia, and roof of lat. ventricle. Neoplasm extended posterior to occipital lobe. No gross neoplasm in temporal lobe except in roof of temporal horn of lateral ventricle. Herniation of left cingulate gyrus beneath falx, bilateral cerebellar pressure cones, midbrain and pons compressed. Medulla and cerebellum unremarkable	Right homonymous hemianopia, right parietal lobe lesion. No involvement of thalamus and optic radiations deep in left parietal lobe
3	59	F	20/40 OU	Left upper homonymous quadrant-anopia	Negative	Somnolence, headaches, fatigability, 14 mo. Craniotomy disclosed meningioma in right sylvian fissure. Expired one day later	Surgical specimen, a meningioma, had been removed intact. Necropsy disclosed marked cerebral edema, with right temporal pressure cone. A fresh meningioma was noted in right parietal occipital region. Cerebellum and brain stem were normal	This case demonstrated a focal temporal lobe lesion producing a Meyer's loop field defect yet with a negative O.N. sign. Death was from uncontrollable cerebral edema and a postoperative hemorrhage
4	76	M	R 20/70 L 20/30	Right homonymous para-central scotomas-macular splitting	Negative	Visual disturbance, 9 mo. Right III nerve palsy 1 mo. prior to death	Adenocarcinoma of lung, with metastases to occipital lobes, bilateral; right III nerve, and cauda equina. Metastases were not to left occipital lobe and including superior occipital lobe. Tumor also in meninges medial to right occipital lobe, but not involving underlying brain. Cerebral atherosclerosis, with several tiny foci of softening in cortex, most prominent in right frontal lobe. Tumor also in cerebellum, on falx, vermis, and in midbrain. Metastases to right superior orbital fissure noted, with III nerve spared intracranially	Metastatic disease to left occipital lobe produced a right homonymous para-central scotoma and a negative O.N. sign. There was no evidence of parietal lobe involvement in this case
5	59	M	Normal	Normal, pseudo-hemianopia to left	Negative	Forgetfulness, 8 mo. Ignored left side of environment, 1 wk. Headache. Craniotomy revealed subcortical right frontal lobe tumor but no extension to premotor strip. Expired next day	Astrocytoma, grade 3-4, right frontal lobe, infiltrating; left frontal lobe, well circumscribed nodule. Right temporal lobe, some infiltration. Tumor in areas of gyri, but not extending into right frontoparietal region. Small hemorrhage in right basal ganglia. Brain-stem and cerebellum had no lesions	This patient had a pseudohemianopia. The only other abnormality on eye exam was a positive O.N. sign. Clinical examination showed a right parietal lobe lesion. This case of a frontal lobe tumor with a positive O.N. sign was shown at autopsy to extend into right parietal lobe

* RHH = Right homonymous hemianopia.
LHH = Left homonymous hemianopia.
† O.N. Sign = Optokinetic nystagmus sign.

TABLE 1 (Continued)

Case	Age	Sex	Vision	Fields*	O.N. Sign†	Symptoms and Course	Anatomic Findings	Comment
6	44	M	Normal	Normal	Negative	Seizures, dizziness, lethargy, rigidity right upper extremity, 3 yr. Left frontal lobectomy for glioma; patient expired on 3rd day	Mixed glioma, left frontal lobe. Enlarged left hemisphere; herniation left jugulate gyrus beneath falx; right cerebellar tonsils extruded beneath occipital lobe, peduncle, midbrain. Large operative defect, left frontal. In remaining white matter of frontal cortex, left basal ganglia, and corpus callosum, brain tissue yellowish and soft	This mixed glioma of left frontal lobe produced symptoms for 3 yr. There was no field defect, but a pseudohomonymous hemianopia of the left eye, basal ganglia and anterior internal capsule were involved on left, but extension into parietal lobes was lacking. This was a frontal lobe tumor without parietal extension, in which the O.N. sign was negative
7	45	F	—	LHH incongruous	Positive	Seizures, 10 yr. personality change 2 yr. Headaches and incontinence, 1 mo. Bilateral papilledema. At right frontotemporal craniotomy, a glioma was seen astride sylvian fissure. Expired on 18th day	Astrocytoma. Bilateral cerebellar and temporal pressure cones. On section, right superior and middle frontal convolutions were soft and necrotic. Further posteriorly, right thalamus internal capsule, basal ganglia, and part of white matter of parietal and temporal lobes were involved in tumor. Small cavity in right thalamus. Brain stem and cerebellum were normal	On gross examination this might have been considered a frontal lobe tumor with a positive O.N. sign. However, on section there was tumor in right parietal lobe and microscopic exam revealed a diffusely infiltrative glioma
8	38	M	R 20/40 L 20/50	LHH, splitting fixation	Positive	Headaches, dizziness, hallucinations, 3 mo. Encephalography was consistent with deep large right temporal tumor. Subsequent removal of glioma at craniotomy. Expired on 3rd day	Glioblastoma multiforme, right temporal lobe; ant. horns, both lateral ventricles. Tumor presented on inferior surface of right temporal lobe, extending distinctly separated from brain tissue. It obliterated right inferior horn of lateral ventricle, and a part of R. globus pallidus. Subependyma of anterior horns involved	Although further anatomic study would have been helpful, as midportion of ant. horn of lateral ventricles was involved, the O.N. sign and parietal involvement probably occurred in this temporal lobe glioma with positive O.N. sign
9	38	M	—	RHH, complete	Positive	Headaches and speech difficulty, 3 wk. Aphasia, R. central facial weakness, and diminished pinprick over entire R. body. Craniotomy revealed left temporoparietal glioma, extending deeply into thalamus. Expired 5 mo. later	Glioblastoma multiforme, extensive involving almost entire left hemisphere. Cystic area 2.5 cm. in diameter filled with greenish coagulum in parietal cortex. Tumor extended to frontal lobe, most extensive in temporal and parietal lobes, and extended posteriorly to within 2 cm. of occip. lobe. Thalamus involved on left. Brainstem normal	This extensive glioma involved almost entire left hemisphere, and was most extensive in the thalamus, temporal and parietal lobes. An asymmetric optokinetic response was present.
10	63	F	20/20 O.U.	RHH, incongruous	Positive	Abrupt onset, global aphasia. Auricular fibrillation. 14 mo. later, right VII and VIII nerve weakness, nystagmus, positive O.N. sign. Posterior fossa exploration. Death on 60th day	Two external lesions: (1) neoplasm in right cerebellar hemisphere, involving V, VII, VIII. (2) Extensive infarct, left parietal, with atrophy of entire superior temporal gyrus. Extended from anterior horn of lateral ventricle into temporal lobe extended to within 3 mm. of posterior horn, and radiations were involved. No other lesions seen in brain	Difficult interpretation in this case because of two lesions: (1) old left parietal infarct, embolic. (2) more recent medulloblastoma of cerebellum. At any rate, a defective O.N. response was noted as well as a left parietal lobe infarct.

TABLE 1 (Continued)

Case	Age	Sex	Vision	Fields*	O.N. Sign†	Symptoms and Course	Anatomic Findings	Comment
11	60	F	Vision and fields could not be done because of aphasia		Positive	Aphasia and R. hemiparesis, 2 mo. Papilledema. Death 3 wk. later	Glioblastoma multiforme, discrete, left parietal lobe. Extending from 3.4 cm. behind frontal pole to plane of midthalamus. It lay above plane of sylvian fissure, and extended mesially to insula. Foremost part, sharply differentiated from edematous centrum semiovale. Compression of right crus; small hemorrhage in basis pontis	Definite parietal lobe extension of this parietal lobe glioma, with a positive O.N. sign
12	28	F	Normal	Normal	Negative	Malignant melanoma on back, recurred after excision. Headaches, vomiting, dragging left foot, seizures 4 days. Died on 6th hospital day	Three large metastatic lesions in brain—largest in left parietal region. It was firm, brown, and surrounding white matter edematous; cortex did not appear to be involved. Similar metastases in right frontal and right posterior temporal lobes. No other brain lesions	Although no defect was present in either visual fields or optokinetic nystagmus in this case, a definite left parietal metastasis was present. Death may have occurred too rapidly for clinical manifestation of these lesions
13	54	M	—	RHH, complete, splitting fixation	Positive	Numbness, right extremities; poor vision to right, 3 mo. Diminished pinprick over right body and face, 2 yr. later, basilar ischemia progressed. Cortical blindness, dysplasia, dysarthria	Advanced atherosclerosis of basilar-vertebral system; with complete basilar thrombosis. Both posterior cerebral arteries totally occluded. Softening both peduncles, midbrain, upper pons, & lower cerebellar hemispheres. Right posterior left occipital lobe similar, but more recent softening, right occipital lobe. Right ant. cerebral and a minor branch left middle cerebral both virtually occluded	This patient had progressive atheromatous disease of basilar system. Findings support early involvement of left posterior cerebral artery. The O.N. sign was positive early. Later examination of visual fields and optokinetic nystagmus did not disclose any abnormality so that no conclusions could be drawn about cortical localization. The left parietal lobe was involved in this case
14	45	M	Cortical blindness; transient RHH, then clearing		No O.K. response to right side	Headaches, 3 wk. Hypertension disclosed 12 hr. after onset of RHH in 12 hr. Patient named direction to drum correctly but had no response to either side, 24 hr. later, full fields but still O.N. response totally absent. Convulsions, aphasia, coma, and later death	Diffuse encephalopathy, probably vasculopathic in nature. Numerous lesions throughout brain. Slightly larger lesions in deep right parieto-occipital cortex, which were relatively recent infarcts. Arteries showed markedly proliferated endothelium. Similar changes in cerebellum	This patient died of a diffuse vascular disease of unknown cause within 8 wk. of onset of cortical blindness, with transient cortical blindness, with RHH, and clearing, occurred later. Despite cooperation and ability to tell side of rotation, no O.K. response at all. Lesions seen in R. parietal lobe; left parietal not studied histologically but similar process there appeared likely
15	49	M	20/20 OU	IHH, macular splitting	Positive	Seizures, 2 wk. Left hemianesthesia. Craniotomy disclosed right parietal tumor	Glioblastoma multiforme	Parietal lobe lesion; positive O.N. sign
16	49	F	20/20 OU	Normal early; 3 mo. later, LHH	Negative; later, equivocal	Headaches and seizures, 1 mo. Craniotomy disclosed right occipital tumor	Glioblastoma multiforme	Occipital lobe lesion; negative O.N. sign
17	26	M	R 20/30 L 20/20	Left upper quadrant-anopia	Negative	Seizures. Right temporal lobectomy had been done previously for tumor; fields unchanged in 21 month follow-up	Astrocytoma	Temporal lobe lesion; negative O.N. sign
18	45	M	15/100 OU	LHH, complete, incongruous	Positive	Seizures, 10 mo. Craniotomy disclosed right parieto-occipital tumor	Glioblastoma multiforme	Parietal lobe lesion; positive O.N. sign

TABLE 1 (Continued)

Case	Age	Sex	Vision	Fields*	O.N. Sign†	Symptoms and Course	Anatomic Findings	Comment
19	60	F	20/20 OU	LHH, macular sparing	Negative	Personality change, 12 yr. Craniotomy: large right occipital parasagittal tumor	Meningioma	Occipital lobe lesion; negative O.N. sign
20	23	F	R 16/30 L 16/20	LHH, complete, macular sparing	Negative	Occipital headaches, 3 mo. Craniotomy: right occipital tumor	Glioblastoma multiforme	Occipital lobe lesion; negative O.N. sign
21	59	M	OU; counts fingers	RHH, complete	Positive	Confusion, headache, disturbed vision, 3 wk. Glaucoma. Craniotomy: left pa- rieto-occipital tumor	Glioblastoma multiforme	Parietal lobe lesion; positive O.N. sign
22	19	F	—	RHH macular splitting	Negative	Dysphasia, alexia, R. hemiparesis, bloody spinal fluid. Craniotomy: vas- cular lesion on surface of left parietal region	Arteriovenous malformation, λ (gross exam; biopsy not done)	Parietal lobe lesion; negative O.N. sign
23	56	M	R 20/100 L 20/50	LHH, denser below	Positive	Headaches, 5-6 wk. Nephrectomy 8 yr. before for hypernephroma. Craniotomy disclosed solitary metastasis to right parietal lobe	Hypernephroma	Parietal lobe lesion; positive O.N. sign
24	57	F	20/30 OU	LHH, macular splitting, denser below	Positive	Headaches 12 hr. left hypalgnesia. Right thalamic lesion suspected. Craniotomy: arteriovenous malformation, R. tem- poral lobe, with intracerebral hema- toma	Arteriovenous malformation	Temporal lobe lesion; positive O.N. sign, but extent of intracerebral hema- toma could not be exactly defined
25	25	F	20/70 OU	RHH, macular splitting, denser incongruous	Positive	Headaches, intermittent episodes con- fused, 4 yr. Craniotomy revealed large left temporal lobe tumor	Meningioma	Temporal lobe lesion; positive O.N. sign. Large tumor present, as 85 grams of tissue resected at surgery
26	44	F	Normal	Normal; but pseudo- hemianopia	Negative	Headache, 2 wk. Dragging left leg, 1 wk. Craniotomy revealed right frontal lobe tumor	Glioblastoma multiforme	Frontal lobe lesion; negative O.N. sign
27	4	F	Cortical blindness; cleared to RHH		Negative	Auto accident, 8 days previously. Cra- niotomy: left occipital subdural hema- toma	Subdural hematoma	Occipital lobe lesion; negative O.N. sign
28	51	M	20/20 OU	LHH, denser below, incongruous	Negative	Headache, seizures 5 wk. Craniotomy: metastasis to tip of right temporal lobe	Adenocarcinoma of rectum	Temporal lobe lesion; negative O.N. sign
29	51	F	20/20 OU	RHH, macular splitting	Negative	Visual difficulty, 2 mo. Craniotomy: small mass inferior portion of left poste- rior temporo-occipital region	Carcinoma of ovary	Occipito-temporal lesion negative O.N. sign
30	14	M	20/20 OU	LHH, denser below	Positive	Weakness, right hand, 6 mo. Dragging R. foot, 2 wk. Craniotomy revealed a cyst, right parietal lobe	Cyst, right parietal lobe, probably glio- matous	Parietal lobe lesion; positive O.N. sign
31	54	F	20/20 ⁺ OU	Normal	Positive	Carcinoma of breast, 2 yr., treated with X-ray. Seizures, dizziness, left hemi- paresis 2 mo. Craniotomy revealed a solitary metastasis to right superior parietal lobule	Carcinoma of breast	Parietal lobe lesion; positive O.N. sign

ions of the value of a positive optokinetic nystagmus sign have varied,^{2,6-8} most authors have considered it as indicating disease of the posterior half of the cerebrum. The rare instances of alleged frontal lobe disease^{8,7} causing an asymmetric optokinetic response have not excluded parietal lobe involvement. It is evident that more information is needed on anatomically verified cases to resolve the significance of a positive optokinetic nystagmus sign.

Our clinical experience has borne out the impression of Cords and Kestenbaum that this simple test is a reliable sign of parietal lobe localization in cerebral disease, and that one can with reasonable assurance differentiate temporal and occipital lobe hemianopias from those of parietal origin by this method. The purpose of this report is to present briefly the clinical and pathologic findings in 31 patients in whom the optokinetic response has been carefully studied, and which have been anatomically verified. In 14 of these, complete autopsy examinations are available. In 17 additional cases the findings were verified by craniotomy and biopsy.

MATERIAL

Selected for review are 194 cases of cerebral disease seen by one of us (D.G.C.). Of this group, 29 have come to necropsy in the Massachusetts General Hospital. In 14 of the latter, and in 17 other cases confirmed by surgery, a specific statement regarding optokinetic nystagmus is available. These 31 cases were further analyzed. The autopsy and surgical cases are presented separately (table 1).

DISCUSSION

Recent clinical experience with cases of cerebrovascular disease has strengthened our impression that a positive optokinetic nystagmus sign indicates *parietal* lobe disease. The anatomic evidence presented suggests that this is the case. A symmetric optokinetic response was elicited to both sides in three of the autopsied cases (3, 4, and 6). These had lesions of temporal, occipital, and frontal

lobes, respectively, with no parietal involvement. Six of the autopsied cases had positive (asymmetric) optokinetic nystagmus signs, and parietal lobe involvement was present in each (1, 2, 5, 7, 9, and 11). However, five of the autopsied cases present difficulties in interpretation. Thus, Cases 10 and 13 both have dual lesions (basilar artery thrombosis and medulloblastoma of cerebellum). Case 12 presented a metastatic malignant melanoma to left parietal region, and yet normal visual fields and optokinetic nystagmus were found clinically. This patient died within 10 days of onset of symptoms from massive cerebral edema, and perhaps death occurred too rapidly for clinical manifestation of the lesions. The fact that no field defect was present in this case substantiates the fact that there was little parietal lobe dysfunction present at the time of admission. Case 8 is a temporal lobe neoplasm with an asymmetric optokinetic nystagmus sign. However, parietal lobe extension probably occurred in this case, and further anatomic study would have been helpful. Finally, the same factor arises in Case 14, in which only one parietal lobe was studied histologically.

Of the surgically corroborated cases, seven instances of a negative optokinetic nystagmus sign were seen with lesions of occipital, frontal, or temporal lobes, without evident parietal involvement. Further, in six instances of positive optokinetic signs, there was proven parietal lobe disease. Cases 25 and 26 deserve scrutiny, however. In Case 25, an arteriovenous malformation of the temporal lobe presented a positive optokinetic nystagmus sign. However, an intracerebral hematoma was evident in this case, and the extent of the latter could not be definitely determined. Likewise, Case 26 was a left temporal lobe meningioma which presented a positive optokinetic nystagmus sign. Whether or not parietal lobe involvement occurred is not definitely known. The neoplasm was large, however, with 85 gm. of tissue being resected at time of craniotomy.

The method of testing was by rotating a

large optokinetic drum at a moderate rate, and held about 20 inches from the patient. This was done several times to both sides in order to compare the responses. It should be noted that slight asymmetry may be seen at times in normal persons. Only either an absence of response to one side, or a definitely defective and asymmetric response should be called a "positive O.N. sign." An absent response to both sides is nearly always without significance. The most common causes for this finding are that the patient is obtunded, has very low vision, or is ignoring the test. It should be noted that optokinetic nystagmus has been found to be inaccurate in lateralization of brain stem disease in the experience of one of us (D.G.C.), so that the statements made previously apply to its use only in cerebral lesions. The vertical optokinetic response was not interpreted in this study.

SUMMARY

The optokinetic response was analyzed in 14 cases of cerebral disease which came to autopsy examination. Six of these had positive (asymmetric) optokinetic nystagmus signs and were found to have parietal lobe lesions. Three cases presented lesions of temporal, occipital, and frontal lobes respectively, with no parietal involvement. The optokinetic nystagmus sign was negative in these cases. Complicating factors in inter-

pretation of the other five cases have been discussed.

Seventeen cases were studied from the standpoint of optokinetic nystagmus, which were subsequently verified by craniotomy and biopsy. Six of these had parietal lobe lesions with asymmetric optokinetic responses. Four had occipital lobe lesions with a normal optokinetic response to both sides. Likewise, a negative optokinetic nystagmus sign was seen with three temporal lobe lesions and with one frontal lobe lesion. In the three other cases, two were temporal lobe lesions with positive optokinetic nystagmus signs in which rather extensive lesions were present (one intracerebral hematoma, and one neoplasm). One patient was seen to have an arteriovenous malformation of the surface of the left parietal region, with a negative optokinetic nystagmus sign, however.

A frequent occurrence noted in cases with a positive optokinetic nystagmus sign was concomitant involvement of the thalamus. This would not be unexpected with lesions involving the middle and posterior one-third of the optic radiations, deep in the parietal lobe. It is concluded that a positive optokinetic nystagmus sign in cortical lesions is most suggestive of involvement of the *parietal* lobe.

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TOPICAL ENZYMATIC OINTMENT*

A LABORATORY AND CLINICAL STUDY

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Topical enzymatic debriding substances are being used with increasing frequency.^{1,2} They have been applied to various parts of the body in treating abscesses, burns, eschars, ulcers and wounds. A next consideration was their application in similar extraocular conditions. Since these enzymes are proteolytic, their use about the eye did not seem advisable until a rabbit pilot study had been run.

MATERIAL

Enzymatic ointment† consists of 2.0 mg. of crystalline trypsin, 6.0 mg. of crystalline chymotrypsin, and 2.0 mg. of 9-aminoacridine HCl per gm. in a water-soluble base. The former two have a disdain only for necrotic tissue, debris consisting of purulent and fibrinous matter, and slough. Normal healthy tissue is impervious to this type of proteolysis. Toxicity and antigenicity have not been observed using the enzymes topically. Debridement is important since the exposure of healthy tissue will accelerate granulation and healing, and the removal of dead tissue eliminates a medium of growth for pathogenic organisms. Also, the efficacy of antibacterial medication is improved.

The chemical agent, 9-aminocaridine monohydrochloride, is a derivative of acridine ($C_{13}H_9N$) a tricyclic conjugated system.³ The aminoacridines in the solutions used are active against gram-positive and gram-negative organisms, and spore-bearing anaerobes commonly found in wounds with the exception of *Ps. pyocyanea*.⁴ They are chemically compatible with penicillin and sulfonamides and act synergistically with the latter by inhibiting p-aminobenzoic acid formation. They seldom cause drug sensi-

tivity,⁵ and drug-resistance is quite unknown.⁶ Furthermore, the acridines permit active phagocytosis by polymorphonuclear leukocytes. Clinical reports of its use are available,⁷⁻¹⁰ and Rubbo¹¹ reported favorable laboratory results.

METHODS

A six-month laboratory study employing rabbits was set up, using one eye of each animal as a control. Daily instillations of the enzyme ointment were made in the fellow eye. Slitlamp examinations with fluorescein dye were done periodically. Finally the animals were killed and gross and microscopic studies of the control and treated eyes and adnexa were made.* Examination sought evidence of proteolytic insult to the cornea, sclera, or adnexa, and untoward reaction to 9-aminoacridine. A clinical evaluation followed.

RESULTS

Ophthalmoscopic, slitlamp, and microscopic examination of the eyes and adnexa revealed no evidence of alteration or destruction due to the enzyme ointment. The treated eyes showed no unusual local irritation and grossly resembled the fellow control eye. Figures 1, 2, 3, 4 are sections of treated eyes. Figures 1a, 2a, 3a, 4a are sections of the controls. It was interesting to note that in comparing sections of the treated and control palpebral conjunctivas (fig. 1 and 1a) the former usually showed fewer chronic inflammatory cells.

CASES OF INTEREST

CASE 1

A 50-year-old man entered the office for treatment of a cystic fibroepithelial papilloma of the right lower lid which was increasing in size. An

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†Parenzyme ointment supplied by The National Drug Company, Philadelphia, Pennsylvania.

*Dr. A. Bryn, Department of Pathology, Stritch School of Medicine, interpreted the slides.

early childhood chorioretinitis of the right eye leaves him with a correctible acuity of 20/300. Topical instillations of enzymatic ointment were made on three successive days prior to definitive treatment. Slitlamp examination each day using fluorescein sodium dye revealed no corneal abrasion, erosion, or ulceration, or scleral or adnexa changes. No local irritation was noted, nor did the patient have complaint. Surgery was performed to remove the lesion, and the ointment was used postoperatively. There was no evidence of edema or discoloration of the excised area. Recovery was uneventful.

CASE 2

A physician, aged 24 years, was seen some 15 to 20 hours after having been hit accidentally in his right orbit by another's elbow. He presented gross lid edema, discoloration, contusion and laceration, and conjunctival prolapse. He could not part his lids, nor could I, because of attendant pain. Topical enzymatic ointment was applied twice a day along with intramuscular trypsin (one cc.) twice a day. The following day there was a notable decrease in edema and discoloration, and the lids could be opened. The conjunctiva was no longer prolapsed. Two days later, the edema was practically resolved, there was only faint evidence of discoloration, and he had free lid movement. Slitlamp examination was made daily for one week and no abnormal change of the cornea was observed.

CASE 3

A 58-year-old maintenance man was hit in his face with a spray of hot fluid while repairing a refrigerating machine. Some of the fluid entered his left eye. He washed the eye with tap water. His eye became red and pain ensued. Examination revealed a grossly injected left eye with a deep subconjunctival ulceration of the lower lid, infection, and lid edema. A culture specimen was taken, the eye was irrigated, and one-percent atropine solution instilled. Sulfacetamide (15 percent, drops), were used every three hours thereafter. Enzymatic ointment was used topically twice a day. In three or four days there was resolution of the ulcer, suppuration, and lid edema. Slitlamp examination was negative over a period of one month, and the patient experienced no pain. He did complain of some stinging shortly after the ointment was first instilled.

CASE 4

A woman, aged 62 years, with a highly presumptive diagnosis of retinal detachment due to an intraocular tumor of the right eye, was presented to the hospital for enucleation of that eye. Preoperatively she was placed on topical enzymatic ointment twice a day and enteric coated trypsin tablets, one three times a day. No corneal changes nor subjective complaints were noted. Enzymatic and penicillin ointments were instilled postoperatively. At the first dressing change, it was noted that there was minimal swelling and discoloration of the lids and conjunctiva. Two more instillations

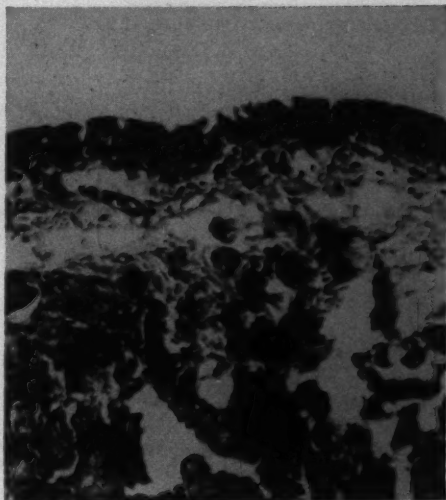


Fig. 1 (Monninger). Section of treated eye.

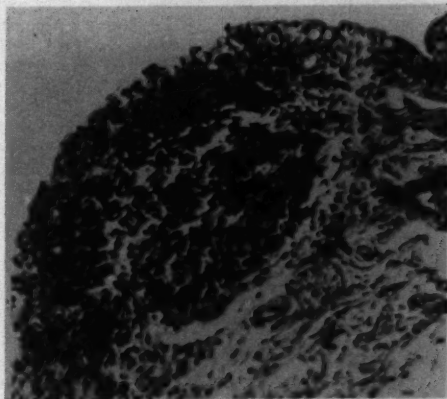


Fig. 1a (Monninger). Section of untreated eye.

of ointment were made. It was felt that clinical recovery from surgery was rather rapid. Implant prosthesis was possible in seven days.

CASE 5

A 40-year-old woman teacher presented herself with complaints of pain and redness of the left eye for several days. She had lost visual acuity in this eye at age eight years due to a scissors injury. Her father, a physician, would not permit removal of the eye at this time. Examination revealed a very soft eye and an opaque cornea. The conjunctiva was grossly injected. Enucleation was recommended and she consented after consultation with another oph-

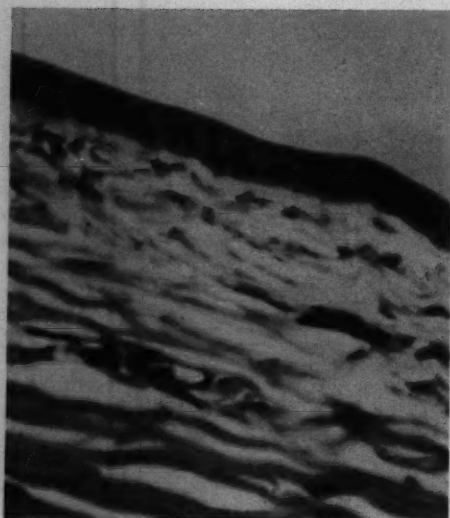


Fig. 2 (Monninger). Section of treated eye.

thamlogist who had followed her for a period of years. Parenzyme ointment twice a day was used preoperatively along with enteric coated trypsin tablets, one three times a day. Slitlamp examination two days later showed no change. Enzymatic and neomycin ointment were instilled after surgery and for several days thereafter. At the first dressing change, there was no discoloration, minimal edema, and no bleeding. She manifested no pain. Within one week she was ready for the first prosthesis. Clinical recovery was unusually rapid.

CASE 6

A man, aged 59 years, received a blow to his right eye in an altercation two years previously. The lens dislocated and absolute glaucoma ensued. Recently his eye became injected and very painful. Enzymatic ointment was applied topically one day preoperatively, after surgery, and three times postoperatively. Very little edema and discoloration were present at the first dressing change. Early prosthesis application was possible. Slitlamp findings before surgery were negative.

CASE 7

A 30-year-old man suffered a gunshot injury to his left eye. A buckshot was localized by the Sweet method. He had been treated elsewhere for six months and enucleation was advised. No effort was made to remove the shot. Traumatic cataract, synechia, and chronic inflammation, and phthisis followed. The eye was enucleated one year after the injury. Enzymatic ointment and enteric coated trypsin (20 mg. daily) were used for two days preoperatively. Slitlamp examination revealed no change of the status quo. Enzymatic ointment and

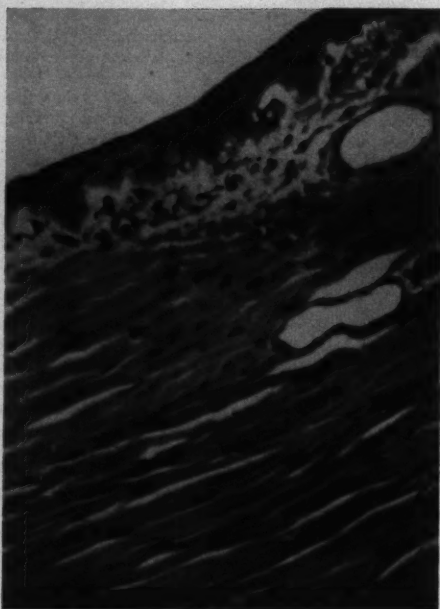


Fig. 2a (Monninger). Section of untreated eye.

sulfa ointment were used after surgery and three times thereafter. Discoloration was absent and edema was of minor consequence. Clinical recovery was markedly rapid.

CASE 8

A man, aged 40 years, whose right eye had been enucleated in childhood presented himself with a lesion of the lower lid. There was a significant local inflammation surrounding the growth. Enzymatic ointment was applied in and around the wound after surgery. There was early resolution of the inflammatory process and minimal wound reaction postoperatively.

CASE 9

A 26-year-old man received a flash burn to both eyes while welding. The brows were singed and both lids were red and edematous with second-degree burns. Enzymatic ointment was applied to both lids twice a day for four days. Debriding and resolution proceeded with dispatch and no infection occurred. Healthy tissue was manifest on the lids. Attendant pain disappeared shortly after treatment was instituted. No scarring developed.

CASE 10

A man, aged 43 years, was working on an ice cream refrigerating unit when it exploded. A strong alkali entered both eyes and covered most of his face. It was noted by those on the scene that the

whites of his eyes became red, and the corneas whitened. He was brought to the emergency room 20 minutes after the accident. In addition to the opaqueness of the corneas, and the injection, there were severe burns of the lids and face. The eyes were irrigated with normal saline.

Examination revealed areas of grayish-white opacities, corneal edema, scleral and conjunctival burns, right eye; and gross grayish-white opacification and edema of the cornea, scleral and conjunctival burns, and ulceration, left eye. All iris and limbal detail was obliterated by the opacification in the left eye. No red reflexes were seen, O.U. Gross outline of people could be seen with the right eye, and only awareness of light intensity change with the left eye.

Atropine and cortisone drops, and antibiotic and enzymatic ointments were instilled, O.U. The enzymatic ointment was also applied to the lids and other burned areas of the face. Dressings were placed over both eyes. The following day examination revealed a small adhesion between the corneal epithelium and conjunctiva of the left eye. This was separated with a glass rod. The patient felt he saw light more sharply and the blur was decreasing. The cornea of the right eye was clearing and he could count fingers at two feet. Details could be seen. The ulcer was grossly reduced. The burns of the lids and face were modifying.

Within three days, the opacity of the left eye had sloughed off and details could be seen. The visual acuity had improved in both eyes and he could see distant detail. Some few Bowman bodies could be seen in the left eye. Fundus details were seen, O.U. Subsequently, the epithelium was again denuded completely. The ulcerated area was resolved. Injection of both scleras was reduced perceptibly. The face burns were repairing nicely.

Within seven days the enzymatic ointment was discontinued and the patient was ready for discharge. He was continued on atropine drops and antibiotic ointment for another week. Eye examination one month later showed essentially normal findings. Both corneas were negative and the recorded visual acuity was 20/20+, O.U. No residual precipitates were noted. Healthy tissue had replaced the burned areas on the face and lids. There was no scarring.

CASE 11

A 30-year-old woman presented herself with a marginal ulcer of the right lower lid and internal chalazia. Enzymatic ointment was instilled for one day and slitlamp evaluation was made 24 hours later. There was no corneal or scleral aberration. The marginal ulcer was improved. Definitive surface diathermy and excision were performed. Enzymatic and antibiotic ointments were instilled and a dressing was applied. Postoperatively the only evidence of surgical intervention was a desiccated pale bleb at the site of the former marginal ulcer. The cornea and sclera were negative. There was no edema, redness, or pain.

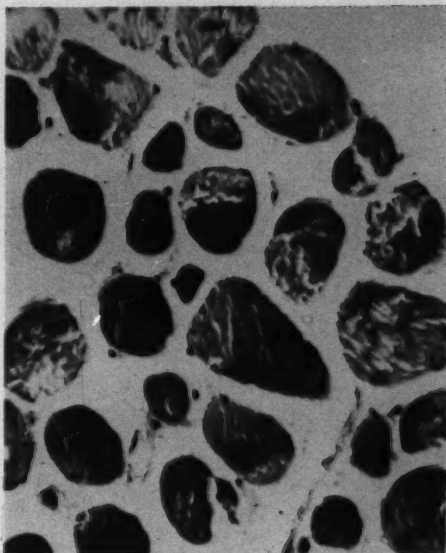


Fig. 3 (Monninger). Section of treated eye.

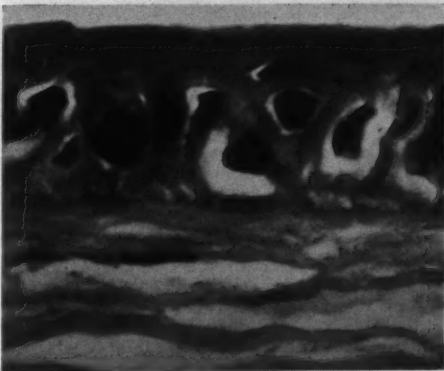


Fig. 3a (Monninger). Section of untreated eye.

CASE 12

A boy, aged six years, was struck in the eye by the edge of a swing. There was gross contusion of the lids, hemorrhage, induration, and edema, and gross subconjunctival hemorrhage. The zygomatic area was also swollen and tender. The palpebral conjunctiva had several tears. The eye and adnexa were cleansed and irrigated. X-ray films, including a Waterhouse, were negative. Enzymatic and antibiotic ointments were used topically and enteric coated trypsin was given orally for four days. Within this time there was definite amelioration of the clinical findings and only a small arc of subcon-

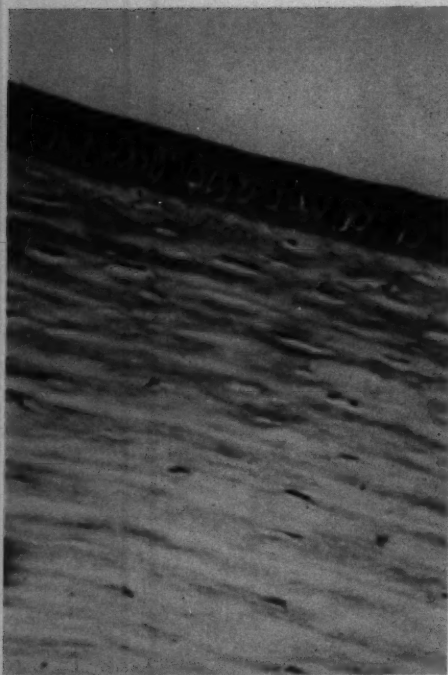


Fig. 4 (Monninger). Section of treated eye.

junctival hemorrhage remained. Serial corneal and scleral slitlamp examinations were negative. There was no report of discomfort due to use of the ointment.

CASE 13

A 38-year-old woman with dacryocystitis was seen. The area over the right sac was swollen, somewhat fluctuant, and red. A stab incision was made, enzymatic ointment and a drain inserted, and systemic penicillin administered. It was felt that clinical recovery was somewhat more rapid than the same procedure would have been without use of the ointment. Later a dacryocystorhinostomy was performed and the sac tissue was in good condition and lent itself well to the procedure.

CASE 14

A girl, aged four years, was operated on for an imperforate nasolacrimal duct opening. The complaints were tearing, suppuration from the puncta, and swelling and redness over the left lacrimal sac. Antibiotic drops were used pre- and postoperatively, and cannula instillation of enzymatic ointment was made. Aqueous trypsin was also used. There was no postoperative swelling or discoloration and recovery was uneventful.



Fig. 4a (Monninger). Section of untreated eye.

CASE 15

A 30-year-old woman with a swollen left upper lid had the feeling of something being affixed to the inner side of the lid. Examination revealed several pustules with circumscribed, red bases. Enzymatic ointment was used topically for several days along with hot compresses. The pustules had opened and drained when seen the following day. No untoward reactions occurred and by the fourth day the inner palpebral tissue appeared healthy and normal. Slitlamp examination was negative. The patient experienced no irritation or pain.

SUMMARY

A control laboratory study was done on rabbits to study the effect of enzymes on normal eyes.

The enzymatic ointment was used topically on 32 clinical cases either as specific or adjuvant therapy in various extraocular conditions. The entire study covered a period of 15 months. No deleterious corneal or scleral tissue effects were noted in the animals or in the clinical cases. No untoward side-effects, such as pain, irritation, or allergy due to the ointment, were noted.

The combination of trypsin and chymotrypsin is effective in promoting healing by debriding and removing necrotic tissue without retarding the normal healing process. By removing the cellular substances and debris

due to inflammation or injury the normal stratum is exposed and this promotes healing. The enzymes do not affect viable tissue.

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USE OF STEEL WIRE IN POLYETHYLENE TUBE IN RETINAL DETACHMENT SURGERY*

REVIEW OF THREE CASES OF DETACHMENT IN APHAKIC EYES

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INTRODUCTION

The 360 degree scleral buckle with the insertion of a globe-encircling polyethylene tube is being used to a considerable extent in retinal detachment surgery. We have encountered several difficulties associated with the placement of the polyethylene tube. In the procedure described by Schepens,¹ the polyethylene tube is threaded under a series of 4-0 black silk sutures which have been placed across the bed of the sclerectomy. The plastic tube, containing a soft suture material such as silk, is easily dislodged from under the 4-0 silk cross sutures.

Another source of trouble has been encountered when the polyethylene tube, after being placed under all of the 4-0 black silk sutures, was to be cut to the proper size. Care must be taken not to cut the suture material

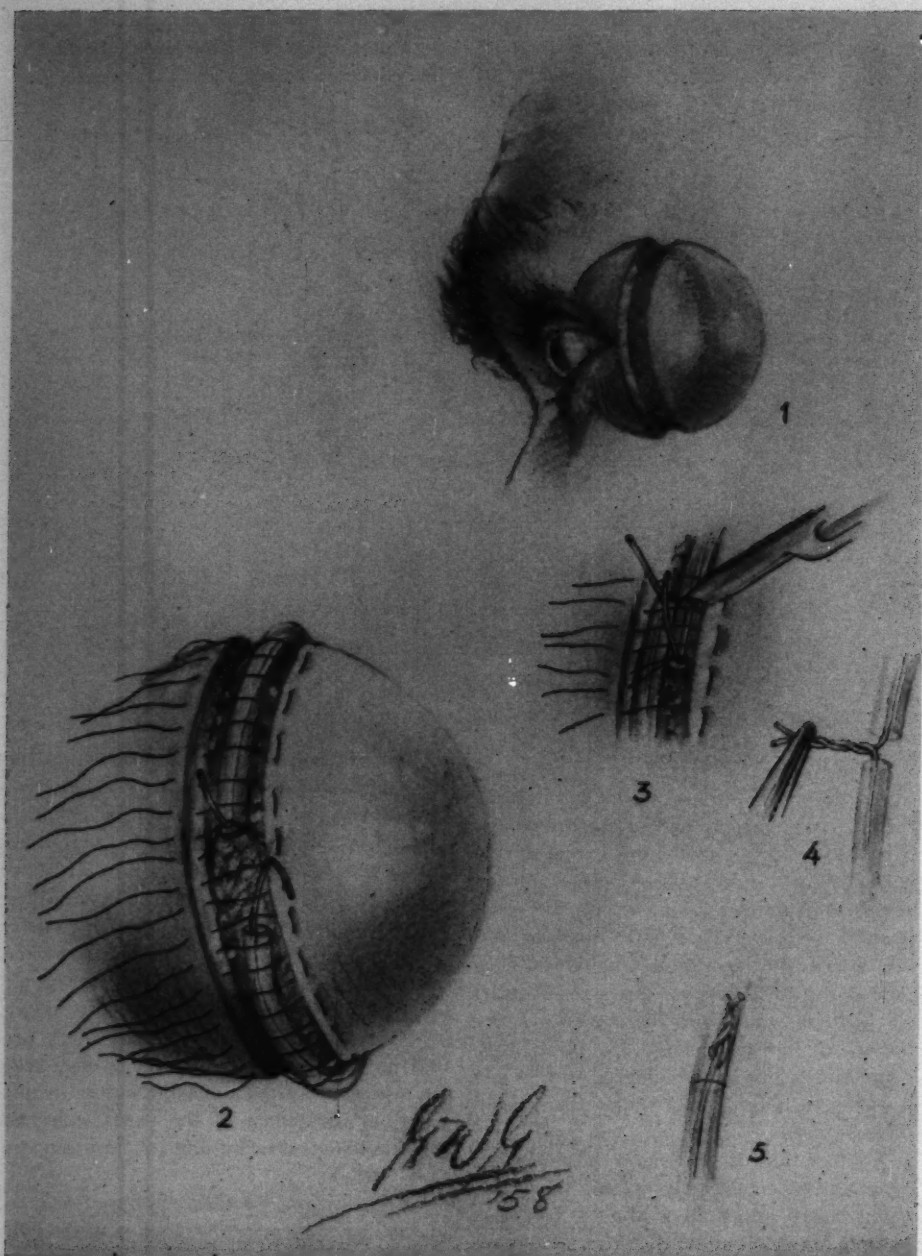
within the polyethylene tube. All too often the suture within the plastic tube was not only cut but was lost somewhere back in the lumen.

One of the greatest difficulties was found in the tying of the retaining suture. This is of the greatest importance because it determines the extent and the permanence of the buckle. It is exasperating to find that, after the knot is tied, there is too much slack in the tube and that the suture has to be untied and redone.

After surgery, a frequent difficulty is premature flattening of the buckle. In some cases in which a soft, nonmetallic substance was used in the lumen of the plastic tube, the buckle flattened in the immediate postoperative period.

On occasion, postoperatively, it may be necessary to identify the position of the polyethylene tube in relation to the buckle for investigative purposes. It is almost impossible to identify the plastic tube when soft ma-

*From the Veterans Administration Hospital.



Figs. 1 to 5 (Lasky and Blumenthal). Semidiagrammatic illustrations. (1) Shows the relation of the groove of the sclerectomy to the globe. (2) Threading of the polyethylene tube with aid of steel wire. (3) Cutting of the polyethylene tube against the steel wire. (4) Twisting the steel wire. (5) Insertion of the twisted end within the tube.

terials are used, either by ophthalmoscopy or by roentgen examination.

METHOD AND MATERIAL

An attempt was made to eliminate the difficulties just enumerated by using a fine stainless steel wire* in the lumen of the plastic tube instead of a soft suture. All other aspects of the procedure are similar to those described by Schepens¹ (fig. 1).

In the threading of the polyethylene tube,[†] the steel wire is bent back over the end of the tube (fig. 2) so as to prevent the tube slipping out from under the cross sutures. To shorten the tube, a Bard-Parker blade No. 15 is used and no care has to be taken to prevent cutting of the steel wire. In fact, the wire is used as a resistance against which to cut the tube (fig. 3).

To tighten the buckle and also to tie the wire, the two ends of the wire are grasped with a small straight mosquito clamp and the clamp is then rotated so as to twist the wire. By this method, the amount of tightening can be accurately set and, if necessary, the buckle can be loosened (fig. 4). After the proper degree of tightness of the buckle is obtained, the twisted end of the wire is tucked into one end of the polyethylene tube so as to prevent any rough edges from being exposed to the ocular tissue (fig. 5).

X-ray films of the orbit were performed in all three cases herein reported in order to determine the position and approximate size of the buckle after surgery.

REPORT OF CASES

CASE 1

H. M., a 64-year-old white man, presented himself at the Brooklyn Veterans Administration Hospital for the first time on January 20, 1956, complaining of loss of vision in the left eye of two weeks' duration. One year prior to admission, the patient underwent an uncomplicated intracapsular cataract extraction of the left eye. Upon examination at the time of admission, the right eye was aphakic but otherwise normal.

* 3-0 Ethicon monofilament surgical steel.

† Clay Adams Intramedic polyethylene tube, inside diameter 0.034 inches, outside diameter 0.050 inches.

Visual acuity was: O.D., 20/20; O.S., light perception with correction. The left eye was aphakic. The retina was detached in its entirety and, in the macular region, there was a small hole with an operculum in the vitreous above it. After a complete work-up, a lamellar scleral resection with a scleral buckle in the temporal half was performed. However, by the third postoperative week, the retina had again separated. The patient was returned to the operating room and, on February 27, 1956, a 360 degree scleral buckle with polyethylene tube containing a steel wire insert was performed, together with electrocoagulation of the bed. Upon discharge, the retina had completely reattached and the patient felt he could "see better" although the visual acuity was unchanged.

The patient was re-evaluated in March, 1958, (25 months postoperative). Visual acuity was: O.S., 20/200 with aphakic correction. Intraocular pressure was within normal limits. The left globe was white and quiet and the retina appeared to be detached inferiorly with several folds in the area (fig. 6). Around the equator and anterior to the ora serrata, there was a marked gliosis with an inbuckling completely encircling the globe. In the buckle, the reflex from the steel wire could be seen. On X-ray examination of the left orbit, the oval of steel wire was seen and measured 16 mm. in the vertical diameter and 17 mm. in the horizontal diameter. The visual field was restricted to a small sector of the inferior nasal field.

CASE 2

N. P., a 71-year-old white man, was first seen at the Brooklyn Veterans Administration Hospital on June 28, 1956, with a chief complaint of blurred vision, O.D., for two weeks. In 1950, the patient underwent a combined intracapsular cataract extraction of the right eye at another hospital (de-



Fig. 6 (Lasky and Blumenthal). Artist's illustration. Case 1, 25 months after last procedure.

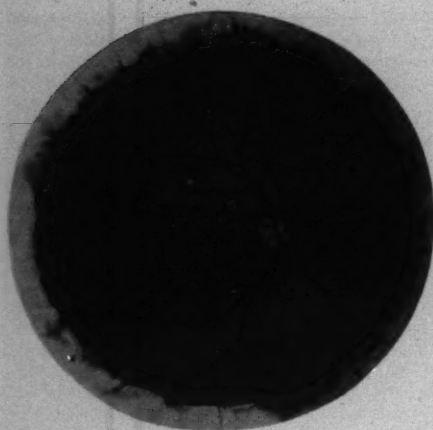


Fig. 7 (Lasky and Blumenthal). Artist's illustration. Case 2, 18 months after last procedure.

tails not available). In 1955, the patient was operated upon for a retinal detachment of the right eye with resultant vision of 20/20 with correction and apparent re-attachment of the retina. Examination at the time of admission to the Brooklyn Veterans Administration Hospital revealed visual acuity: O.D., fingers at one foot; O.S., light perception. The right eye was aphakic. The entire inferior retina was detached. No holes or tears were seen even after repeated examination however, numerous diathermy scars were seen superiorly. The left eye presented marked hypotony and atrophy—the probable end-result of an endophthalmitis after a cataract extraction several years before (although details were difficult to obtain).

On July 9, 1956, the patient underwent a lamellar scleral resection with the insertion of a polyethylene tube 180 degrees inferiorly in the right eye. One month after surgery, the retina was again detached inferiorly. On September 24, 1956, a 360 degree lamellar scleral resection with electrocoagulation of the base and insertion of a polyethylene tube was performed. A steel wire was inserted and the patient had an uneventful recovery. At the time of discharge, the retina was re-attached and the visual acuity was 20/200 in the right eye.

The patient was re-evaluated in March, 1958, (about 18 months after the last procedure). Visual acuity was: O.D., 20/200 with aphakic correction; O.S., questionable light perception. The retina appeared attached (fig. 7). There was some migration of pigment throughout the posterior pole of the retina. The retina was completely attached and for 360 degrees in the equator there was much gliosis. The buckle appeared somewhat flattened. The steel wire reflex was only noted at the 6-o'clock position. Visual field examination revealed a concentric constriction to the 30-degree meridian. X-ray examination revealed that the size of the steel wire was:

vertical diameter, 19 mm.; horizontal diameter, 20 mm.

CASE 3

B. B. was 58 years of age when first seen at the Brooklyn Veterans Administration Hospital in 1954, at which time an uncomplicated, combined, intracapsular cataract extraction was done on the left eye. Resultant vision was 20/20 in the left eye.

The patient was again seen in March, 1957, when he complained of poor vision in the left eye of one week's duration. Examination revealed visual acuity to be: O.D., 20/50; O.S., 20/50 with correction. However, the visual acuity, O.S., fluctuated between 20/50 and 20/100. Numerous vitreous opacities and floaters were seen in the left eye and a bullous detachment of the temporal, superior, and nasal retina was noted. No holes or tears were seen but a large, thin-walled cyst was seen in the region of the pars plana at the 3-o'clock position.

On April 15, 1957, the patient was operated upon and a 360-degree lamellar sclerectomy and electrocoagulation of the bed with insertion of a polyethylene tube containing a stainless steel wire were performed. Postoperatively, examination revealed complete reattachment and the patient was discharged with a visual acuity of 20/50, O.S. This patient was re-evaluated in March, 1958, (approximately 11 months after the operation). Visual acuity was: O.D., 20/70; O.S., 20/50 with aphakic correction. The retina of the left eye was attached (fig. 8). Unusual pigment distribution was noted in the posterior pole. Here, too, in the buckle scar, the reflex from the inserted steel wire was evident. X-ray examination revealed the vertical diameter to be about 23 mm. and the horizontal to be about 21 mm. The patient was unco-operative in the visual field testing. However, the general impression was that the field was moderately constricted.



Fig. 8 (Lasky and Blumenthal). Artist's illustration. Case 3, 11 months after last procedure.

COMMENT

There are several valid reasons for objecting to the use of a steel wire within the polyethylene tube. The production of secondary glaucoma, the production of a foreign-body reaction, and the effects of erosion of the polyethylene tube through the sclera are the most important of these objections. In the three cases reported, there was apparently no secondary glaucoma or foreign-body reaction and, apparently, no ill-effects from the erosive tendency of this procedure in these cases.

An attempt was made to get some rough idea of the diameter of the buckle. Anterior, posterior, and lateral X-ray films of the involved orbit were taken and the vertical and horizontal diameters of the wire were measured. The wall of the plastic tube was about 0.2-mm. thick; therefore, the buckle must have been at least 0.4-mm. smaller than the diameter of the wire. The vertical diameter of the average globe is 23 mm. and the average horizontal diameter is 23.5 mm.² The largest wire diameter was 23 by 21 mm. which indicated a minimum buckle of approximately 0.4 mm. This buckle had been maintained for about 11 months from the time of operation. The other two buckles were about 5.0 mm. and 3.0 mm. in elevation.

The opinion of everyone associated with performance the procedure was that the technique was improved considerably by the use of the steel wire. This was not necessarily associated with a reduction in the operating time (average four hours), but it was felt that the control of the buckle, its placement, and its degree of tightness were greatly facilitated.

It is felt that further study in the use of the steel wire in the 360 degree polyethylene tube is indicated and that, if no untoward effects are encountered, this may facilitate a substantial improvement in the surgery of retinal separation.

SUMMARY

In the modification of Schepens' procedure for retinal detachment herein described, a steel wire is placed in the globe-encircling polyethylene tube. Three cases in which the steel wire was used are reported.

One Nevins Street (17).

ACKNOWLEDGMENT

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STUDIES ON THE HISTOLOGY OF THE INNER WALL OF SCHLEMM'S CANAL*

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In the trabecular meshwork of the human eye there are, according to reconstructions of histologic cross-section series (Dvorak-Theobald), passages, capable of being marked, which connect the anterior chamber with Schlemm's canal. These passages are not merely pores, such as present themselves, for example, on the radiogram of a flat preparation of the canal's inner wall demonstrated by means of radiopaque materials (François, Neetens, and Colette), but rather "pathways" which tend to establish in the mazelike spaces of the meshwork, the shortest possible connection between the chamber and the canal via a strip of subsequent openings.

The various parts of the meshwork (fig. 5) — "membrana iridosclerale," (Rohen), trabeculum corneosclerale, and "pore tissue" (Flocks)—would appear to offer the aqueous humor more outlets than are actually required according to the results obtained by Dvorak-Theobald. Instead of fully using these slits the aqueous is said to advance only by preference pathways which at their respective ends join Schlemm's canal via Sondermann's internal canals, the latter seeming to be amazingly large.

The view holding that unhampered communication between the spaces of the meshwork and the lumen of the canal exists, though supported by numerous researchers, is still open to discussion. However, only recently was the existence of openings in the inner wall of the canal again proved (Ashton, Brini, and Smith, and Rohen, Unger),† by using flat sections and/or prepa-

rations. These findings not only seem to confirm histologically the contrast preparations of inner wall pores in simian and human eyes (François, Neetens, and Colette) but they have also explained both the successful determination of size of such pores by means of chemical particles, bacteria, or latex microspheres (perfusion tests by Huggert, Holmberg, and Esklund, Karg, Garron, Feeney and McEwen) and the gonioscopic observations of blood infiltration, taking place in upstream direction from the canal toward the anterior chamber, after an experimental bulbar hypotonia (Kronfeld, McGarry, and Smith), after artificial damming of the outflow (Duke-Elder), or spontaneously (Unger).

According to the histologic findings in sagittal sections of the chamber angle published by Sondermann, 1930, there are small canals in the outer part of the trabeculae disclosed as afferent vessels and joining the inner wall of Schlemm's canal at a right angle. These canals, lined with endothelium, originate within the intertrabecular fissures of the meshwork and generally run parallel to Schlemm's canal. Sondermann thought these internal canals to be rudiments of fetal vessels which originally drained the blood of the tunica vasculosa lentis into the anterior ciliary veins.

The results of Sondermann's investigation were corroborated by various other researchers, first by Teulières and by Theobald. More recent findings by Dvorak-Theobald would seem to eliminate any doubt as to the existence of these internal canals. Nonetheless, universal agreement on this point has not yet been reached for the one reason that their existence could so far not be proved in tangential tissue sections nor by means of injection methods.

As Ashton, Brini, and Smith point out,

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† Speakman, F.: *Brit. J. Ophth.*, 43:129, 1959.

"the open pathways between the anterior chamber and Schlemm's canal do in fact exist, not in the sense of definite endothelial-lined tubes regularly disposed, as suggested by the term "internal canals," but rather as tortuous communications wandering irregularly and obliquely through the meshwork, like channels through a sponge."

Flocks, who likewise published excellent flat sections of the meshwork, thinks the internal canals discovered by Sondermann to be artefacts.

In the meantime we have found in flat sections of the meshwork definite endothelial-lined tubes that to a high degree of probability are to be identified as Sondermann's internal canals (figs. 3 and 4), (Rohen and Unger; Unger). Our observations and conclusions are stated hereinafter.

INVESTIGATIONS

MATERIALS AND METHODS

When investigating flat sections of the chamber angles of a total of 42 globes, 14 of them (cases of enucleation owing to tumors or perforating injuries) were studied with regard to the normal structure of the meshwork, especially to the inner wall of Schlemm's canal.

The eyes were imbedded in normal manner after formol fixation in celloidin or paraffin. The following stains were preferred: hematoxylin-eosin, van Gieson, resorcinol-fuchsin, azan, orcein, and especially Gömöri (Biel-schowsky). Besides sections of 6.0 μ in thickness, taken tangentially to the scleral outside of the limbus area, so-called thick flat sections of the meshwork (60 to 80 μ) were examined under the stereomicroscope (C. Zeiss). (For the method, see Rohen, 1953.)

We learned by experimentation that the best way to show internal canals in flat sections is by incising in a slightly posterior and exterior direction, that is, not altogether tangentially.

FINDINGS

In the region of the outermost lamellae, the corneoscleral trabeculae gradually merge into a "pore tissue" which constitutes the inner wall proper of Schlemm's canal (fig. 1).

Tangential serial sections of Schlemm's canal evidence the irregular form of its walls. There are all kinds of projections, septa, and bridges of corneoscleral tissue formation protruding into the "pore tissue" of the inner wall and corresponding to the curves and ramifications of the plexiform canal system.

There are likewise a few coarser fiber fascicles belonging to the corneoscleral trabeculae, which cross the zone of the "pore tissue," ramify more and more, taper off, and finally join either the inner side or the outer wall of Schlemm's canal (septum sclerale).

Between these strikingly wide trabeculae there is an extremely fine-meshed network of connective tissue capable of silver impregnation. It originates in the strands of trabecular fibers which finally split up here (fig. 2-a). This means that the originally bundled corneoscleral fibers have changed on the outside into a three-dimensional reticulum. In flat sections situated immediately at the inner side of Schlemm's canal there are openings of various sizes, surrounded by circular argentophile fibers. If we call them "openings" here, it refers only to the connective tissue skeleton of this part and not to the endothelium. From the preparations we used, it cannot positively be decided whether or not these "openings" are closed by endothelia. Most of these openings have a diameter of 20 to 25 μ ; however, there exist also some rotund or polygonal fenestrae of 50 to 75 μ in diameter (fig. 2-b). We assume that the larger of these fenestrae framed with fibers of connective tissue (fig. 2-b) mark the points of junction of an internal canal.

The "pore tissue" is in some places interrupted by vascular structures. In ordinary flat sections these vessels are mostly frag-

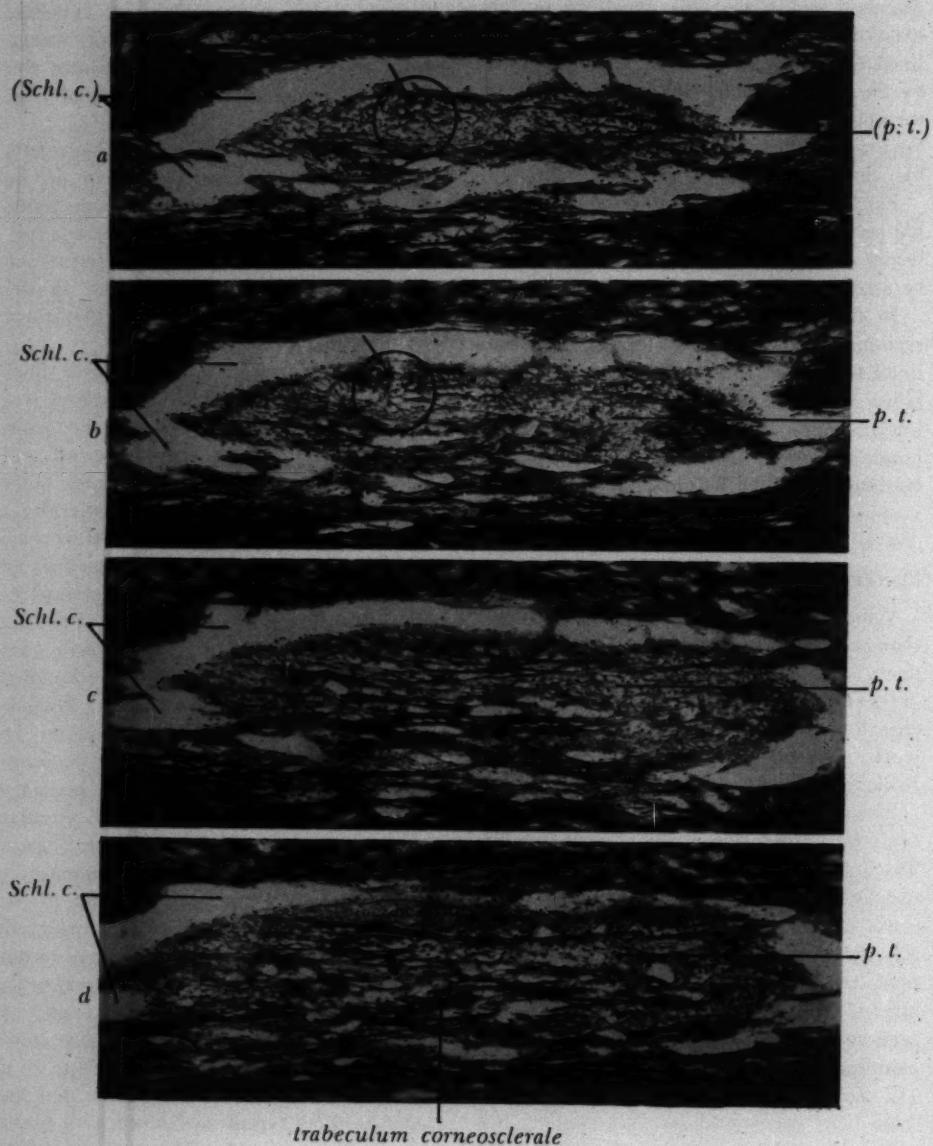


Fig. 1 (Unger and Rohen). (a-d) Flat sections of pore tissue (p.t.). Inner wall of Schlemm's canal (Schl.c.) with groups of fenestrae (see arrows). ($\times 110$.)

mentary and also more or less hidden by cells. When best seen, these vessels turn out to be small tubes originating only in the retiform spaces of the "pore tissue" and joining the inner wall of Schlemm's canal (figs. 3-a and 4).

These tubes attain up to $650\ \mu$ in length and $25\ \mu$ in diameter, the minimum diameter in narrow spots being 8.0 to $10\ \mu$.

The main branch of such a tube consists of an almost straight duct provided with a closed endothelial wall (fig. 3-b).

A main branch of this kind is composed of several (four to six) venous roots, the latter being comparatively short, becoming merged in pairs at an acute angle, and developing from the reticulum of the pore tissue (fig. 4).

Consequently, our observations show the following parts making up such an afferent tube of Schlemm's canal:

1. An envelope of connective tissue being of loose, sievelike consistency at the venous roots and consolidating into a tube further on.
2. A reticulum of endothelia emerging from the adjacent cell groups. In our slides it lines the initial parts of the tube only imperfectly; for the main branch, however, it pro-

vides a layer that is continuous.

In the normal eye such tubes are only to be found in the outermost part of the trabeculae.

Their course is parallel to Schlemm's canal; when joining it, they deviate from their previous course at a right angle. The joining point is mostly situated at the base of the meshwork near the scleral spur.

An individual venous root may be bent like an arch or widened like a funnel (fig. 4-b). Some are very narrow and long drawn-out in the beginning, with indentations in their walls.

The structural pattern underlining these afferent tubes of Schlemm's canal seems to be one well known in comparative anatomy. There are, for example, only negligible differences when compared to the venous roots in the spleen of cats and pigs closely examined by Neubert.

DISCUSSION

We often observed Sondermann's internal canals in meridional section series of the trabeculum. We therefore hold them to be permanent structures. In tangential sections such tubelike structures were more difficult to

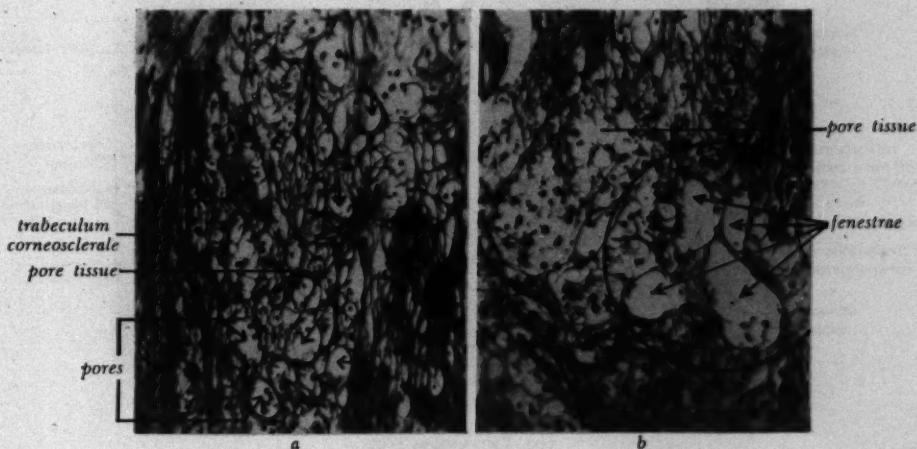


Fig. 2 (Unger and Rohen). Reticulum (pore tissue) of canal's inner wall.
(a) Pores. (b) Group of fenestrae.

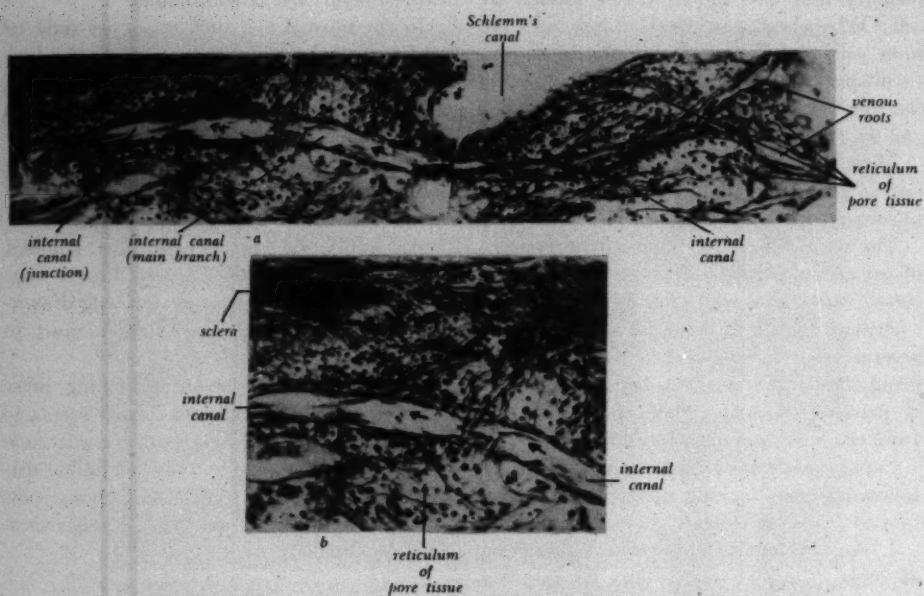


Fig. 3 (Unger and Rohen). (a) Internal canal in flat section. (b) Main branch of internal canal enlarged.

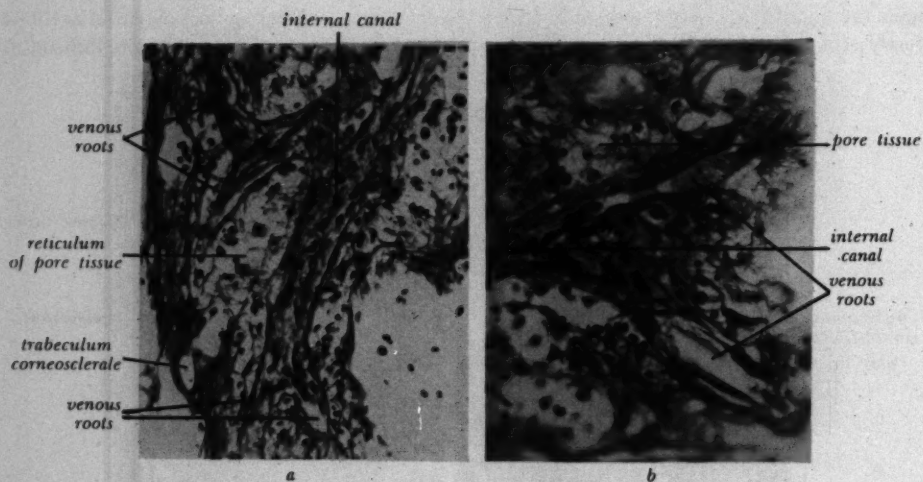


Fig. 4 (Unger and Rohen). (a) Four venous roots of internal canal. (b) Two venous roots.

recognize, yet we did see them in several eyes. In our opinion the comparatively low rate of such findings in tangential sections is to some extent due to the investigating method.

Secondary vascular proliferations, such as those we found in the meshwork with rubeosis diabetica or pulseless disease (Unger), cannot exist in connection with the findings described above, due to the nature of the material investigated and the relevant case reports.

On the basis of our former and present morphologic findings we have conceived the following ideas as regards the pathways of the trabeculae (fig. 5):

For passing through the trabeculae interposed between anterior chamber and efferent vessels the aqueous humor may use the following passages:

a. Openings within the cell groups, spanning the meshes of the uveal meshwork ("membrana iridoscleralis", trabeculum iridis, trabeculum ciliare).

b. Openings of a similar kind amid the corneoscleral meshwork (trabeculum corneosclerale, "pore tissue").

c. Preformed tubes (internal canals) and openings in the inner wall of Schlemm's canal.

The tortuous course of a "pathway" through a number of such lacunae is likely to be conducive to slowing down the aqueous outflow, which is necessary for biologic processes in the trabecular meshwork ("filtering"). By forming here an "endothelial basement membrane system" (Graumann and Rohen; Rohen and Unger) the organism increases the resorbing surface even more.

CONCLUSION

Starting from Dvorak-Theobald's description of the so-called "pathways" of the trabecular meshwork we examined the inner wall of Schlemm's canal by means of tangential sections.

In the "pore tissue" (Flocks) of the outermost part of the trabeculae there were endothelial-lined tubes, which are probably identical with the internal canals according to Sondermann as yet described only in cross sections.

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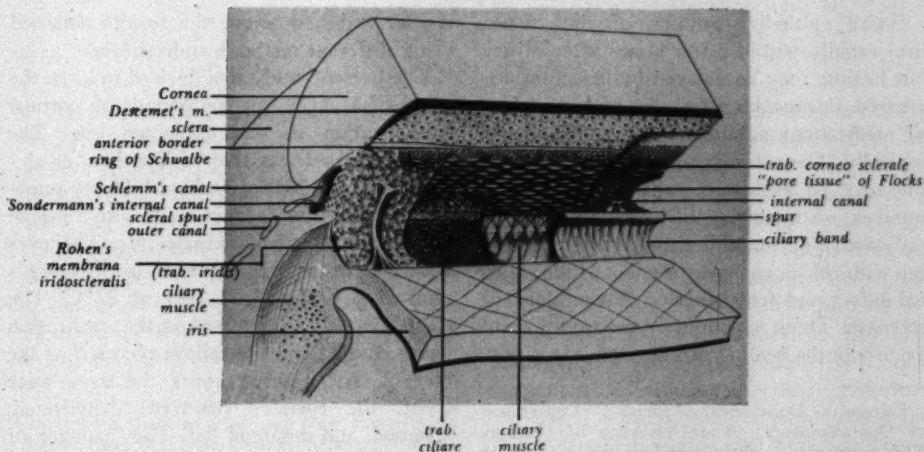


Fig. 5 (Unger and Rohen). Topography of trabecular meshwork. (Painted by Walter Wohlschlegel, Institute of Anatomy, Freiburg i. Br.)

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THE EFFECT OF VARIOUS AGENTS ON CORNEAL EPITHELIZATION*

VERSENATE, METHYLCELLULOSE, VARIDASE, CORTISONE, CHOLESTEROL
 AND METHYLCHOLANTHRENE

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Small epithelial wounds of the cornea heal rapidly within a few hours after injury but healing may be delayed by infection, increased intraocular pressure, and a variety of medications administered systemically or topically. The rate of corneal epithelial healing may be evaluated experimentally by a number of methods: histologic, uptake of radioactive sulfur, mitotic rate after poisoning with colchicine, measurement of the residual defect, and determination of wound tensile strength. These techniques measure different factors in the healing process and it is rarely,

if ever, valid to equate the results obtained using different methods and criteria.

The present study was devised to learn the effect of a variety of compounds on corneal epithelization in the explanted eye. The technique used was that of Buschke, et al.,¹ and Marr and his co-workers.² Thirty punctate corneal injuries were made with a needle in ether-anesthetized female rats. The eyes were enucleated and immersed in Sorenson's phosphate buffer (pH 7.2) at 37°C. The treated eye was immersed in the medication being studied and the fellow eye used as the control. After three hours the eyes were fixed, the corneas removed, dehydrated, strained, and mounted flat. The diameter of each defect was measured with $\times 430$ magnification and the number of healed and un-

* From the Department of Surgery (Department of Ophthalmology), The University of Chicago. This study was aided in part by a grant from the Knights Templar Eye Foundation, Inc., and the L. M. and E. M. Kuppenheimer Fund.

healed injuries in the treated and control eyes compared. Five pairs of eyes were used for each compound studied.

Two-percent methylcellulose solution did not modify the rate of epithelial migration of the untreated eye.

One-half-percent cortisone solution had no effect on epithelial migration. This finding is in agreement with the majority of earlier reports which have shown cortisone to delay fibroblastic proliferation, but to have minimal or no effect on epithelial healing. One-half-percent cholesterol solution was studied as a control and also had no effect on epithelial repair.

One-half-percent methylcholanthrene, a carcinogenic agent, hyaluronidase (45 units per cc.) and Varidase (Streptokinase, 1,000 units per cc. and Streptodornase, 250 units per cc.) were without effect.

Calcium versenate in 0.05 molar concentration loosened the corneal epithelial cells so that there was dissociation and fragmentation of the syncytial epithelial layers. The epithelial cells exfoliated, leaving debris centrally in the wound. The area of epithelial involvement was three to 10 times the diameter of the original wound, and healing was markedly delayed.

SUMMARY

Two-percent methylcellulose, Varidase, 0.5-percent cortisone, 0.5-percent cholesterol, hyaluronidase, and 0.5-percent methylcholanthrene have no effect on epithelization of corneal defects in the explanted eye. Versene dissolves the syncytia of the epithelium and delays epithelial migration.

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EXPLORATORY SCLEROTOMY*

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The purpose of this paper is to discuss the clinical practicality of exploratory sclerotomy as a diagnostic procedure in cases of suspected but questionable intraocular tumor.

There have been several scattered reports on the subject of intraocular biopsy either by aspiration or directly through a transcleral incision but the procedure has not been widely adopted, perhaps because the dan-

gers of orbital spread or seeding have been overemphasized or the operation itself has seemed too formidable.

In answer to these objections, there is little doubt that the possibility of direct extension or orbital seeding is quite real but can be held to a minimum by meticulous technique (changing instruments) and immediate enucleation if indicated. The procedure per se although fraught with some danger of intraocular hemorrhage and vitreous loss is certainly quite minimal compared to the scleral resection and buckling operations for retinal detachment now commonly in use.

* From the Department of Ophthalmology, Yale University College of Medicine, New Haven, Connecticut, and the New Britain General Hospital. Presented at the Fourth Postgraduate Seminar of the Manhattan Eye, Ear and Throat Ex-House Surgeons, April, 1959.

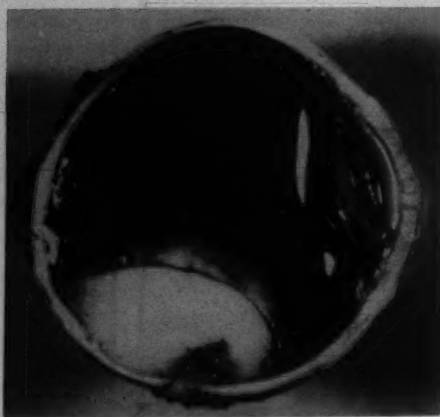


Fig. 1 (Taylor). Gross specimen of enucleated eye containing metastatic bronchogenic carcinoma. The sites of the transcleral section and intraocular biopsy are apparent.

For whatever other objection there might be, one cannot help but be impressed by the fact that we continue to read reports in the literature that eyes are still being enucleated that might have been saved had exploratory sclerotomy been employed as a final diagnostic procedure. Badtke recently reported on 12 such cases.

The hasty and regrettable decision to remove an eye that later proves to contain an inflammatory mass (tuberculoma), hematomia, choroidal angioma, connective tissue beneath the retina, or some other benign lesion rather than the suspected malignancy should be cause enough to make any ophthalmologist who has experienced this embarrassing situation seriously consider the merits of transcleral exploration.

CASE PRESENTATION

In October, 1956, I was called in consultation by an internist to see a 56-year-old white woman who had experienced easy fatigability and weight loss over the past two months. These symptoms had been attributed to emotional stress as her father was seriously ill but during the past week she had begun to complain of a disturbance in vision in her left eye described as a "pinwheel effect." Examination revealed an extensive retinal detachment involving at least two thirds of the entire area. The detachment was most marked in the lower quad-

rants but extended well up beyond the midline just nasal to the disc and in a curved line just beneath and temporal to the macula. The superior portions of the detachment were bullous in type but the inferior portions appeared to be solid and smooth and the retinal folds did not move with motion. No retinal tears could be found and transillumination revealed increased density in the lower quadrants. Examination of the right eye was negative.

The patient was hospitalized and placed on bed-rest with the head elevated 45 degrees. Repeated examination failed to reveal any tears in the retina and the detachment became progressively worse during this period, spreading to the macular region with further visual loss. Consultation with two other ophthalmologists confirmed the impression of an intraocular mass as the causative factor.

In the meantime the chest X-ray films revealed a moderately large mass in the left mediastinal region. My attention shifted from the detachment to the chest mass and the probable connection between the two. My clinical impression was that this was probably a bronchogenic carcinoma with metastatic spread to the eye.

A chest surgeon was next called in. He bronchoscoped the patient but the findings proved to be negative. In addition, X-ray studies of the long bones and extensive physical examination failed to reveal any evidence of metastatic disease other than the possibility of a metastatic lesion in the left eye producing the detachment.

The chest surgeon was anxious to explore the chest and possibly resect the hilar mass but was opposed to this if we were certain that the detachment in the left eye was due to a metastatic deposit in the choroid. Clinically, I believed this to be the case and preferred to allow time to resolve the problem. The relatives of the patient were somewhat hyperemotional however, and demanded that something be done to establish a definite diagnosis. I decided that intraocular exploration was in order for it would be less taxing to the patient than an exploratory thoracotomy and would probably answer two questions at once.

If the ocular exploration proved the existence of a metastatic lesion this would solve the retinal detachment problem, as well as eliminate an exploratory thoracotomy. If the intraocular lesion proved to be something different (choroidal angioma, inflammatory mass, and so forth), then thoracotomy would have to be done and the detachment treated as a separate disease.

Under general anesthesia, the inferior rectus was recessed for exposure and a five to six mm. scleral incision was made along the 5-o'clock meridian, centered over a point 14 mm. from the limbus that was selected preoperatively as the area of greatest intraocular density. As the deep scleral fibers were approached two opposing 4-0 black silk mattress sutures were placed in the wound margins and looped aside. The remainder of the scleral fibers were severed and directly under them a white firm tumor mass came into view; it had completely replaced the choroid in the area.

Although probably unwise, it was decided to expose the tumor further by dissecting the sclera from the surface of the growth under both margins of the incision. The appearance and feel of the tumor was typical of carcinoma tissue. A biopsy was taken and sent to the laboratory. The instruments that had come in contact with the carcinoma were removed from the table and fresh instruments were used to close the scleral and conjunctival wounds.

To avoid the possibility of carcinoma mushrooming through the scleral wound into the orbit, with subsequent proptosis and pain, the eye was removed immediately. Under the circumstances this may have been unwise for it only added to the patient's anxiety.

The pathologist's report on both the biopsy and enucleated eye was bronchogenic carcinoma, highly malignant in type. The patient died six months later.

COMMENT

I. INDICATIONS

If the clinical diagnosis of intraocular malignancy is almost certain, as would be the case in some easily recognized malignant melanomas with positive P^{32} studies, there would be little need for intraocular exploration and the procedure would even be contraindicated because of the possibility of spreading the malignancy into the orbit by seeding. When there is sufficient doubt about the nature of an intraocular mass so that the surgeon in charge is unable to reach a decision, the primary indication for exploratory sclerotomy is clearly defined. In the case reported the cause of the detachment, the nature of the chest mass, and the possible relationship between the lesions were the doubtful factors that decided for intraocular exploration.

II. PROCEDURE

The suspected site and limitations of the tumor should be localized preoperatively. The anesthesia should be general and the plane should be deep enough to provide complete relaxation of all the orbital muscles to minimize the chances of vitreous loss.

A conjunctival incision is made at the appropriate site down through Tenon's capsule to the sclera. If necessary, one or more of the extraocular muscles may be

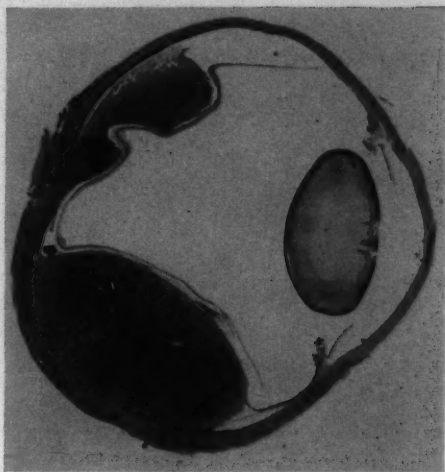


Fig. 2 (Taylor). Microscopic section of globe containing metastatic bronchogenic carcinoma.

incised from the globe to permit adequate exposure. A final check of the location should be made with the ophthalmoscope before incising the sclera. The limits of the tumor may be marked with methylene blue. The location of the scleral incision should be governed by the area of maximum elevation and density of the mass, with careful attention being paid to the ampullae of the vortex veins. A meridional incision five to six mm. in length is then made through the sclera. Before incising the last few strands of sclera, two appositional edge-to-edge mattress sutures (Dermalon or 4-0 silk), similar to the type employed by Shafer for his vitreous implants, should be placed. They serve as a safeguard if immediate closure of the wound is necessary. The sutures are looped aside and the remaining scleral fibers are severed. From here on the ensuing steps in the operation will depend on the findings.

If a malignancy of the choroid is present, either primary or metastatic, there will be little need to fear vitreous loss or hemorrhage for the tumor will probably have replaced the choroid and will be directly under the sclera in full view. Palpation with an instrument will reveal that the mass is solid.

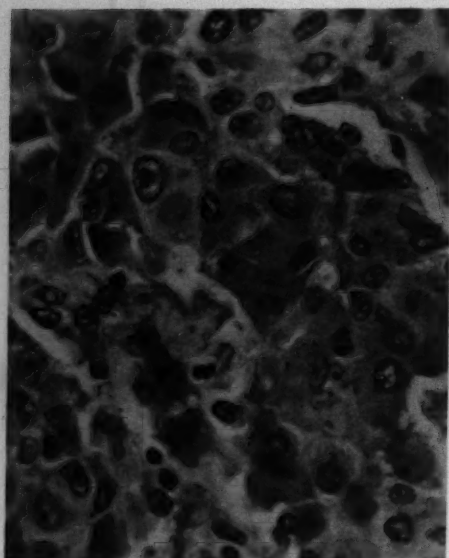


Fig. 3 (Taylor). Biopsy specimen, demonstrating carcinoma.

It may even be possible to undermine or dissect the sclera from the mass for purposes of better visualization and exposure; this, however, increases the risk of spreading tumor cells, particularly if there is scleral invasion. Greater exposure can also be obtained by converting the original meridional incision into a V-shaped trap-door incision as suggested by Schepens and Schwartz. The appearance and feel of the tumor tissue may be helpful in deciding the nature of the lesion. An adequate biopsy should then be taken for both frozen section and stained slides.

If, after penetrating the sclera, choroid presents or herniates through, it should be perforated with a diathermy needle. If fluid or vitreous presents, the scleral incision should be extended in both directions and diathermy punctures should be made to rule out the possibility of the mass having been missed. If nothing but fluid is encountered, it would be wise to collect some by direct aspiration through one of the holes in the choroid for microscopic analysis according to the Papanicolaou technique.

If no fluid or vitreous presents when the choroid is punctured with a diathermy needle, the presence of some type of solid or semi-solid mass, which has not destroyed the choroid, is indicated. The safest procedure is to obtain an aspiration biopsy if possible. This can be done if the mass is a partially organized hematoma or a soft tumor or an inflammatory mass with some liquefaction necrosis. If aspiration biopsy fails, one must carefully open the choroid, using the diathermy unit to control any bleeding, inspect the underlying mass directly, and take tissue for biopsy. If the appearance of the presenting tissue is highly suggestive of a hemangioma of the choroid, it would be wise to disturb the tumor as little as possible in order to avoid intraocular bleeding and to proceed with penetrating diathermy in an effort to obliterate the angioma, as suggested by Schepens and Schwartz.

If a diagnosis of primary malignancy can be made (malignant melanoma), immediate enucleation is indicated to minimize the possibility of orbital spread. Under most other circumstances it would be possible to change instruments, close the wound, retain the eye, and await the detailed pathologic report. Enucleation could then be done several days later, if necessary, or the eye allowed to remain, depending on the findings. The surgeon must bear in mind that, by attempting this procedure, he is trying to give the patient the benefit of the doubt rather than primary enucleation; however, he must be ready to proceed with enucleation if indicated. Exploratory sclerotomy should be looked upon as a well-planned diagnostic procedure and a sincere effort to utilize every means available to establish the etiology of a questionable intraocular mass before undertaking an enucleation that may later be regretted. Wider adoption of this procedure may well reduce the number of needless enucleations.

SUMMARY

1. Intraocular exploration through a transcleral incision is recommended as a valuable diagnostic procedure in all cases with a sus-

picious intraocular mass in which enucleation is being seriously considered but there is reasonable doubt as to the etiology of the lesion.

2. If an intraocular lesion can be definitely diagnosed clinically as a malignancy, there is little need or justification for transcleral exploration, for the possibility of orbital seeding is very real although perhaps overemphasized. In my opinion the main indication for exploratory sclerotomy exists when there is reasonable doubt in the minds of the attending surgeon and his consultants as to the nature of an intraocular lesion, even though malignancy is strongly suspected.

3. The procedure itself is relatively simple and the dangers of serious surgical complications, such as massive intraocular hemorrhage or vitreous loss with collapse of the globe, are more apparent than real.

4. The technique of the operation is outlined.

5. A case is presented in which the exposed intraocular mass proved to be a metastatic deposit from a bronchogenic carcinoma. This suspected clinical diagnosis was proven by intraocular biopsy. Immediate enucleation was carried out.

6. Carefully planned intraocular exploration in cases of suspected malignancy should be looked upon as a sincere effort on the part of the surgeon to establish a diagnosis in order to avoid an enucleation that may later be regretted. It would seem that the possibility of saving an eye offsets in some degree the calculated risk of orbital seeding should malignancy be encountered.

32 Grove Hill.

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EXPERIMENTAL HYPHEMA IN RABBITS*

I. THE EFFECT OF MYDRIATICS AND MIOTICS ON THE RATE OF ABSORPTION

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In spite of the relatively common occurrence of hyphema in ophthalmologic practice, there is very little agreement in the ophthalmic literature as to the course of therapy to be undertaken. Severe impairment of

vision and even enucleation of the eye is sometimes necessary following complications which result from hyphemas. Most authors agree on bandaging the eyes and bedrest but, as to the use of mydriatics or miotics, there is practically no concurrence.^{6, 17, 21, 22, 31, 33, 34} There are three schools of thought in this regard:

1. Constrict the pupil in order to allow a larger surface of the iris for better absorption of blood.

* From the Division of Ophthalmology, Department of Surgery, University of California Medical Center. This investigation was supported by grant-in-aid B-929 from the National Institutes of Neurological Diseases and Blindness, United States Public Health Service.

2. Dilate the pupil to put the iris and ciliary body at rest to prevent further bleeding and posterior synechias.

3. Do not attempt to influence pupil size on the assumption that neither mydriasis nor miosis affect the rate of absorption of the hypHEMA.

The present report describes a study undertaken to determine the rate of absorption of blood from the anterior chamber and the effect of mydriatics and miotics on this absorption curve. Using techniques described in a previous report,²⁵ tagged red cells were injected into the anterior chamber of rabbits' eyes and the rate of exit from the eyes was determined by counting the radioactivity of the peripheral blood cells.

METHODS AND MATERIALS

I. LABELING WITH Cr^{51}

Five to seven cc. of whole rabbit blood were obtained either by heart puncture or from the marginal ear vein and placed in a test tube containing one cc. Strumia ACD (Abbott) solution^{6,27} and two to five drops heparin (10 mg./cc., Upjohn). To 3.5 to 4.5 cc. of whole blood were added 200 to 300 microcuries Cr^{51} of specific activity not less than 15,000 $\mu\text{C}/\text{mg.}$ of metal.^{16,27} After swirling gently to mix, it was incubated at 80°F. plus or minus 2°F. for not less than 90 minutes, with occasional gentle mixing.⁵ The "tagged" blood was then washed three times by adding 10 cc. of Ringer's solution, centrifuging for five to 10 minutes at 2,000 rpm, and removing the supernatant with a rubber-bulbed pipette. The supernatant of the last two washes was counted in a deep well-type scintillation counter. If the third wash was not under 20,000 counts per minute, the blood was washed again. Immediately after incubation the activity of the plasma and the cells indicated that 85 to 95 percent of the Cr^{51} had been taken up by the cells as previously shown by workers Read,¹⁸ Stohlman and Schneiderman,²⁶ and Tudhope.²² After the wash washing, the uptake in

the red cells was fixed by the addition of six (plus or minus) mg. of ascorbic acid per 3.5 cc. of whole blood.^{1,18}

II. ANIMALS USED

Albino rabbits averaging 1.5 kg. weight were used throughout the study. At the termination of each experiment all animals were killed and disposed of according to radiation safety specifications.

III. ANESTHESIA

Light chloroform anesthesia was used throughout. One to two drops of Pontocaine hydrochloride (0.5 percent) were instilled in the eye at the beginning of anesthesia.

IV. INJECTION OF THE ANTERIOR CHAMBER

The anterior chamber of one eye of each rabbit was entered at the limbus of the cornea with a 27-gauge, one-half-inch needle attached to a 0.25-cc. syringe. After withdrawing 0.05 cc. of the aqueous humor, the syringe was quickly exchanged for one containing 0.05 cc. tagged cells which were promptly injected into the anterior chamber. After withdrawal of the needle, the animal's head was elevated to an upright position.

V. OBTAINING AND TREATMENT OF PERIPHERAL BLOOD SPECIMENS

After anterior chamber injection, peripheral blood specimens were obtained at predetermined intervals by bleeding from the ear vein into a heparinized vial. These specimens were counted immediately in a well-type scintillation counter.

VI. ABSORPTION TIME CURVE

After anterior chamber injection of tagged (Cr^{51}) red blood cells an absorption curve was determined by obtaining and counting samples of peripheral blood every hour for seven hours. This determination was done in a series of five experiments, using a total of 57 animals distributed as shown in table on next page.

TIME (HR.)	NO. OF ANIMALS
1	5
2	5
3	10
4	9
5	9
6	11
7	8

The statistical data were then evaluated by the following two methods to produce the curve seen in Figure 1: (1) The mean (average) counts per minute (cpm) for total number of animals at each hourly interval were plotted on semilog paper; (2) a standard, consisting of the cpm per 1.0 cc. of injected blood, was recorded for each experiment. The standard of experiment No. 1 was empirically designated as equal to 100 percent — K. The standards of the following experiments were reduced to a percentage of K and the cpm per animal increased or decreased as necessitated by its standard being plus or minus K. The mean of the adjusted cpm per each hour were plotted on semilog paper.

VII. PROCEDURE IN USE OF MYDRIATICS AND MIOTICS

A. Mydriatics

1. Atropine sulfate ointment, two percent (Abbott),⁹ was instilled in the eye 18 hours and one hour before injection of the tagged cells into anterior chamber, immediately afterward, and three to five hours thereafter.

2. Phenylephrin hydrochloride, 10 percent Viscous (Neosynephrine, Winthrop),⁷ was instilled in the eye one hour before the anterior chamber injection, immediately after, three and five hours afterward.

B. Miotics

1. Physostigmine ointment, 0.25 percent (Eserine, Abbott),^{9,13,20} was instilled in the eye 18 hours and one hour before the anterior chamber injection; immediately afterward and three and five hours afterward.

2. Pilocarpine ointment, one percent,^{11,13,19,29} was instilled 18 hours before

anterior chamber injection; pilocarpine solution, four percent, one to two drops, one hour before and just preceding the anterior chamber injection.

3. Di-isopropyl fluorophosphate, 0.1 percent (DFP) (Floropryl, Merck, Sharp, and Dohme),^{2,12,23,24} instilled one hour before anterior chamber injection, immediately afterward, three and five hours afterward.

VIII. DURATION OF EXPERIMENTS

All experiments were terminated seven hours after the injection of the anterior chamber with the tagged cells. Peripheral blood specimens for counting were obtained at three, five, and seven hours after the anterior chamber injection.

IX. MACROSCOPIC OBSERVATIONS

The treated eyes were observed macroscopically for degree of mydriasis or miosis at the time of injection and at the time of obtaining peripheral blood specimens. These observations were tabulated to determine efficiency of inducement and maintenance of the action of the drug in question. Macroscopic observations of the amount of blood remaining in the eyes of all animals (treated and controls) at each specimen withdrawal time were recorded and similarly tabulated.

X. EVALUATION OF ISOTOPIC DATA

The percent absorption for each animal for the seven-hour duration of the experiment was obtained by reducing the cumulative seven-hour cpm to a percentage of its

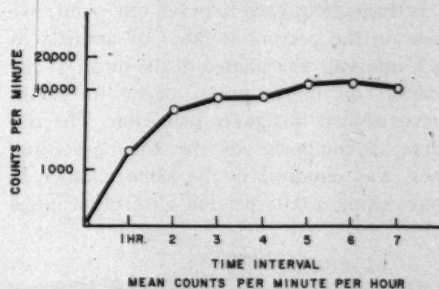


Fig. 1 (Sinskey and Krichesky). Mean time curve.

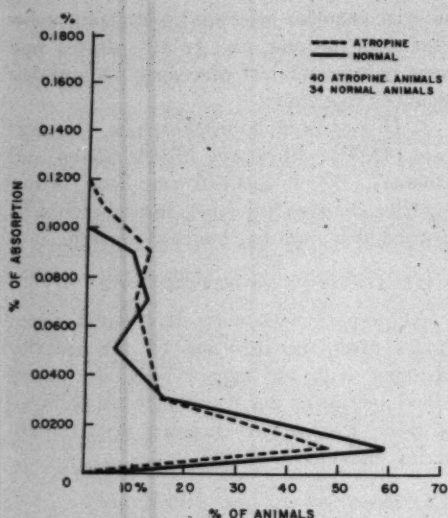


Fig. 2 (Sinskey and Krichesky). Rate of absorption of tagged red blood cells in atropinized eyes as compared to normals.

standard (cpm/1.0 cc. of injected blood). The blood dilution factor was considered to be a constant since it fell within acceptable statistical limits of variability. To adjust for deviation of isotope activity between experiments and give a graphic picture of T testing of the data the percentage of absorption per animal was plotted on square root graph paper. The number of animals in each 0.02 percent absorption interval was reduced to the percentage of total number of animals in the group. Variability of number of animals in each group necessitated this procedure. Due to sufficiently even distribution of animals throughout each interval, one point, expressing the percent number of animals in each interval, was plotted at the mean of the interval on linear graph paper to obtain curves shown in figures seen later. The last curve, a composite of the four preceding ones, was obtained in the same manner as above using a 0.05 percent absorption interval.

RESULTS

The absorption time curves (fig. 1) reveal that rabbit hyphemas are absorbed most

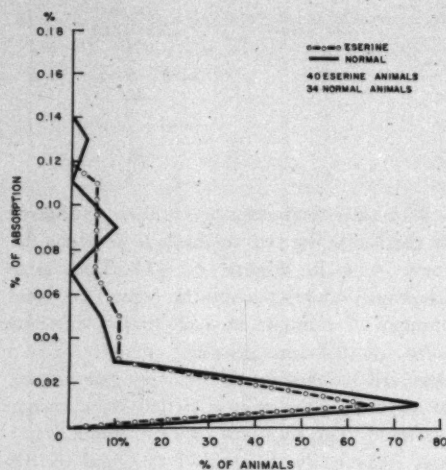


Fig. 3 (Sinskey and Krichesky). Rate of absorption of tagged red blood cells in eserinated eyes as compared to normals.

rapidly in the first two to three hours after injection, with a plateau beginning at three hours. It was noted throughout the study

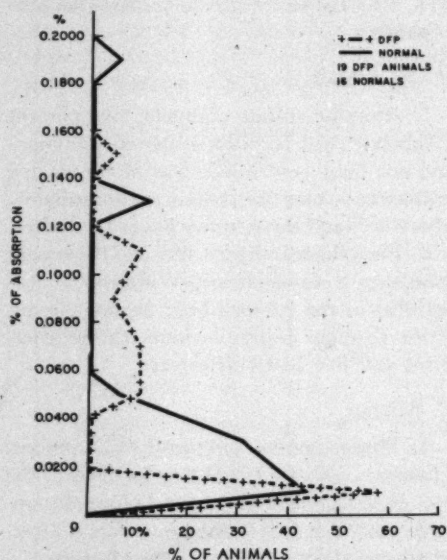


Fig. 4 (Sinskey and Krichesky). Rate of absorption of tagged red blood cells in eyes treated with DFP as compared to normals.

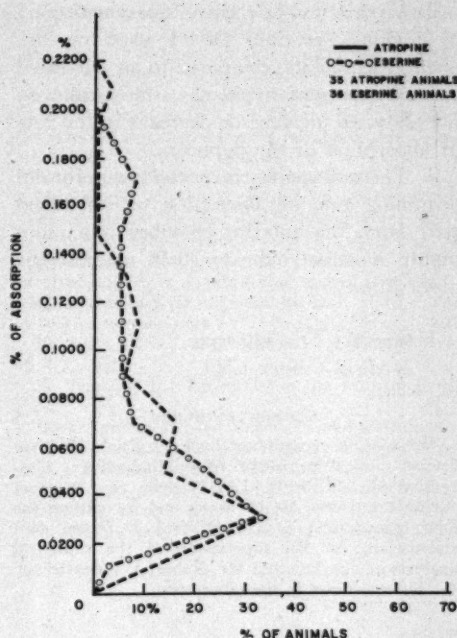


Fig. 5 (Sinskey and Krichesky). Rate of absorption of red blood cells in atropinized as compared to eseriniz eyes.

that excellent mydriasis was obtained with atropine and neosynephrine. Eserine and DFP produced a high degree of miosis; whereas, pilocarpine was almost uniformly ineffectual.

Eyes treated with neosynephrine and pilocarpine showed no appreciable difference in the rate of absorption of the hyphema from that of the control eyes.

Preliminary studies with atropine, eserine, and DFP showed considerable promise in altering the rate of absorption of a hyphema but larger series of rabbits revealed no statistically rated difference from the control rabbits (figs. 2, 3, and 4). This was also true whether eyes were atropinized or eseriniz (fig. 5). In Figure 6, where the curves representing absorption rates of atropine, eserine, DFP-treated eyes, and the control group are superimposed over the seven-hour duration of the experiments is revealed.

CONCLUSIONS

Since rabbit hyphemas are absorbed most rapidly in the first two to three hours after injection it can be concluded that treatment to increase and maintain absorption should be undertaken as soon as possible after the onset of hyphema. Since mydriatics (atropine, neosynephrine) and miotics (eserine, DFP) used on hyphemas in rabbits, compared to an untreated control group of hyphemas, statistically do not show increase or decrease in the rate of absorption, it is concluded that alteration of pupil size by these

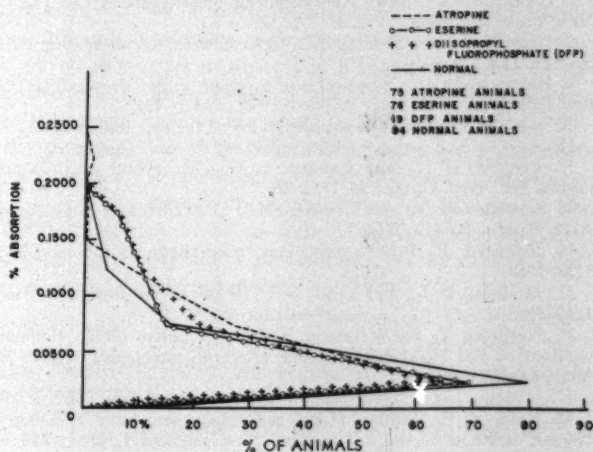


Fig. 6 (Sinskey and Krichesky). Rate of absorption of tagged red blood cells in atropinized and eseriniz eyes, those treated with DFP, and normal eyes.

drugs has no beneficial effect upon the rate of absorption of experimental hyphemas. Therefore, the use of either mydriatics or miotics in treatment of hyphema for the purpose of hastening its absorption is not indicated.

Macroscopic observations of the progress of the absorption of the rabbit hyphema proved to be much less sensitive than the radioactive tracer technique. Conclusions based on the macroscopic observations would be invalid, statistically.

Further experimental studies using similar techniques are indicated in order to discover methods by which hyphemas may be absorbed more rapidly.

SUMMARY

1. Rabbit hyphemas are absorbed most rapidly in the first two to three hours as determined by using an isotopic tracer (Cr^{51}) technique.

2. Mydriatics (atropine, neosynephrine) or miotics (eserine, DFP) used on hyphemas in rabbits, compared to an untreated control group of hyphemas, statistically do not show an increase or decrease in the rate of absorption of the hyphema.

3. The radioactive tracer technique for determining rate of absorption of red blood cells from the anterior chamber is a more highly sensitive indicator than macroscopic observations.

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ULTRASTRUCTURE OF PIGMENT GRANULES OF RETINAL EPITHELIUM*

I. COW'S EYE

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Previous reports describing the anatomic details of the retinal pigment granules as seen with the electron microscope, although conflicting in some respects, have paved the way for further studies of these structures.

It is the purpose of this paper to report certain observations made with the electron microscope on the retinal pigment granules of the cow eye.

In 1950 Sebruyns¹ examined for the first time the pigment granules in the retinal pigment epithelium with the electron micro-

scope. Each granule of the ox eye was found to be oval and possessed at one of its extremities a previously unobserved filamentous process. The filament seemed to be obliquely striated, but in all probability this was due to the effect of torsion. Sebruyns² believed that these filamentous processes made it possible for the pigment granules to change their position with changes in the intensity of light. And he stated that each granule was composed of several hundred microgranules.

Subsequently Binder and Orth³ (1953), François, Rabaey, and Vandermeerssche^{4,5} (1953), and Kinugasa⁶ (1953) failed to observe the filament.

Binder and Orth³ found two types of pig-

* From the Department of Ophthalmology, Indiana University School of Medicine. This study was supported by a grant from the Knights Templar Eye Foundation. Presented before the Midwestern Section, Association for Research in Ophthalmology, Saint Louis, April 19-20, 1958.



Fig. 1 (Taniguchi). Electron micrograph of pigment granules. (Platinum-shadowing, $\times 7,800$.)

ment granules in the human eye, the first type was spindle-shaped with an irregular boundary; the second one, spherical with small grains on its surface; they felt that these observations suggested an internal structure in the pigment granules. Later, Takeuchi⁷ (1956) observed a kind of filament on the pigment granules of the human eye but no internal structure.

Thus, the opinions concerning filaments and internal structure of the retinal pigment granules have been in some dispute up to the present time.

METHODS AND MATERIALS

Cow eyes were obtained soon after slaughter. They were hemisected sagittally. The vitreous body was dissected by means of a weak jet of distilled water or isotonic saline, and the sensory part of the retina lifted off with blunt-toothed forceps, exposing the pigment epithelium. A few very thin pieces of pigment epithelium were detached with the aid of a tiny curette and floated on a watch glass containing either



Fig. 2 (Taniguchi). Electron micrograph of pigment granules. (Platinum-shadowing, $\times 11,000$.)

distilled water, hypotonic saline (0.2, 0.4, and 0.6 percent), or horse serum (60, 80, 100 percent with distilled water as diluent). In a few hours the pigment epithelial cells burst, and the mixture was transferred to a centrifuge tube by pipette to allow the pigment granules to separate and settle for a period of 24 hours. The settled granules were then drawn up with a micropipette and placed on each of a number of grids covered with a parlodion membrane. The suspensions were examined after evaporation had taken place at room temperature for about 24 hours.

When hypotonic saline was used for cytolysis, a small quantity of granules at the bottom was drawn up with a pipette and put into distilled water in another centrifuge tube for the purpose of washing away sodium chloride crystals. The tube was shaken slightly until the solution was uniform. After 60 minutes, some of the settled granules were drawn up and placed on the prepared grids.

Since, after evaporation, crystals of sodium chloride still often prevented examination, at times distilled water was dropped on the dried grid to dissolve the crystals.

In order to observe the effect of clearing agents on the pigment granules, additional quantities of the suspension were treated with chloramine-T (four percent) for 24 hours, prior to placing on the grids.

To determine the resistance of fuscine granules to changes in the medium, other portions of the suspension were treated with buffer solution (veranol acetate buffer—pH 5.0, 6.0, 7.0, 8.0, 9.0, and 10.0 and ethyl alcohol 40, 50, 60, 70, 80, 90, and 100 percent) for 24 hours prior to placing on the grids.

After preparation and evaporation of the suspension, the pigment granules were examined with the RCA electron microscope, type EMU-2, with direct magnifications from 1,600 to 20,000 times, and with enlargements up to 98,000 times. Some of the grids were shadowed with platinum.

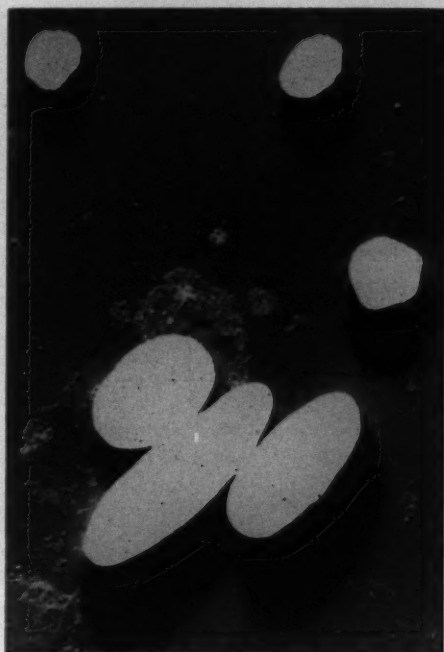


Fig. 3 (Taniguchi). Three major types of pigment granules. (Platinum-shadowing, $\times 16,000$.)

FORMS OF PIGMENT GRANULES

The pigment granules assume a number of shapes as seen in the low magnifications (figs. 1 and 2). They were: cigar-shaped, egg-shaped, spherical, and irregular. The granules were arbitrarily placed in one of these groups depending on shape. Figure 3 shows the three major types. A small percentage which have been grouped together as "irregular" assume threadlike, angular, crescentic, or other shapes (fig. 1).

In Table 1 it can be seen that the cigar-shape form was the most common (about 80 to 84 percent); whereas, the egg-shaped type was seen in eight to 10 percent, the spherical in six to 10 percent, and the irregular type in two or three percent. Five hundred pigment granules were counted in each of the three major areas of the retina (peripheral, equatorial, and central) in order to obtain the above frequency distribution.

TABLE 1
THE PERCENTAGE OF VARIOUS FORMS OF PIGMENT
GRANULES IN THE THREE MAJOR AREAS
OF THE RETINA

Form	Area of Retina		
	Central (%)	Equatorial (%)	Peripheral (%)
Cigar-shaped	84.4	80.4	79.6
Egg-shaped	7.8	10.2	9.0
Spherical	5.8	6.4	9.8
Irregular	2.0	3.0	1.6
Number examined	500	500	500

The frequency of the four types of pigment granules was not found to vary significantly in the different areas of the retina inspected (table 1).

SIZE

The range of the size of three forms of pigment granules in the three major areas of the retina is shown in Table 2 and was obtained by measuring 100 pigment granules of each type.

Although the size of the pigment granules appeared to decrease in the periphery, an analysis of variance revealed this trend not to be significant.

SURFACE

The surface of the granules which seems smooth at lower magnifications is found to be irregular at larger magnifications (fig. 4).

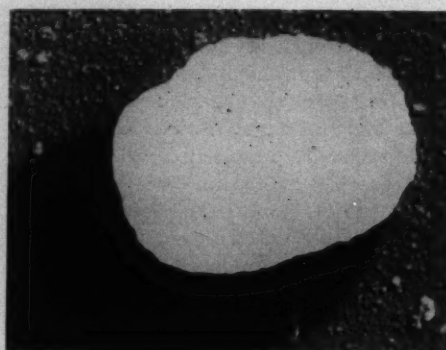


Fig. 4 (Taniguchi). The surface of the granule seems bumpy and irregular. (Platinum-shadowing, $\times 50,000$.)

INTERNAL STRUCTURE

Neither the cigar-shaped, the egg-shaped, nor the spherical granules were penetrated by the electron beam, so only contrasting pictures could be made. An internal structure within the granules was observed only after pretreatment with 80-percent alcohol; none was seen after chloramin-T, buffer solutions, or ethyl alcohols of lower percentage. Under the action of the 80-percent ethyl alcohol, the pigment granules shrank and developed irregular projections.

In some instances granules split into a large number of tiny daughter granules; these microgranules appeared to be contained in a thin membranous sac which was destroyed by the 80-percent alcohol, allowing them to escape. Each granule split into mi-

TABLE 2
THE RANGE, IN MICRONS, OF THE SIZE OF THREE FORMS OF PIGMENT GRANULES IN THE
THREE MAJOR AREAS OF THE RETINA

		Area of Retina		
		Central (μ)	Equatorial (μ)	Peripheral (μ)
Cigar-shaped	Length	0.88-3.24	0.83-3.15	0.52-3.06
	Width	0.22-0.85	0.16-0.82	0.14-0.74
Egg-shaped	Length	0.30-2.10	0.36-1.67	0.24-1.58
	Width	0.19-1.02	0.22-0.95	0.14-1.01
Spherical	Diameter	0.16-1.13	0.14-1.12	0.15-1.09

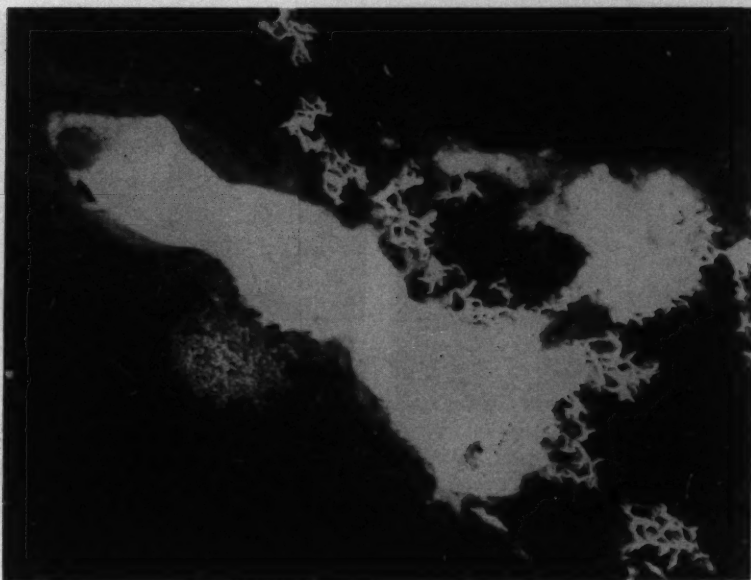


Fig. 5 (Taniguchi). The cigar-shaped granule is splitting into many cigar-shaped microgranules. ($\times 37,000$.)

crogranules which assumed the cigar-shape, egg-shape, or spherical-shape of the parent granule (figs. 5, 6, 7, and 8).

The length of the microgranules was less than 0.2μ in the cigar-shaped ones, and the diameter of the spherical ones was less than 0.1μ .

FILAMENTOUS PROCESSES

When distilled water was used for cytolysis, no filaments were found attached to any of the granules (figs. 1, 2, 3, and 4), but after the pigment epithelium was treated with hypotonic solutions of saline or horse serum, the granules had a thin filamentous

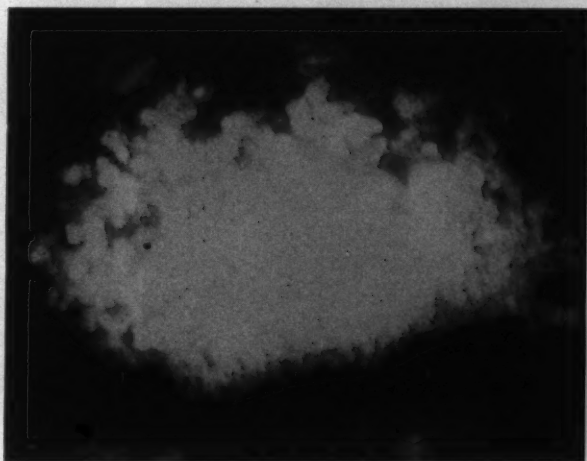


Fig. 6 (Taniguchi). The egg-shaped granule splits into numerous tiny egg-shaped microgranules. ($\times 96,000$.)



Fig. 7 (Taniguchi). The granule consists of many tiny spherical microgranules. ($\times 88,000$.)

process at either or both extremities. Occasionally, a filament appeared to connect two granules. Figure 12 shows two filaments



Fig. 9 (Taniguchi). Cigar-shaped granule has a filament at both extremities. ($\times 20,000$.)

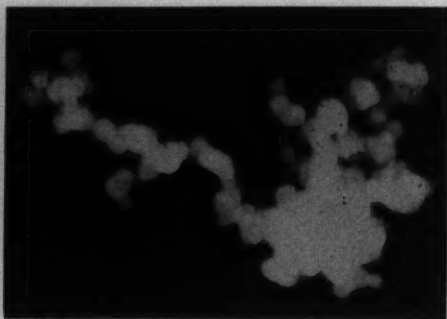


Fig. 8 (Taniguchi). The granule splits into many spherical microgranules. ($\times 73,000$.)

and three granules. One of the filaments was connected at one end of a granule, while the other one was divided into two thinner strands before connecting to its granule.

The most common connections between

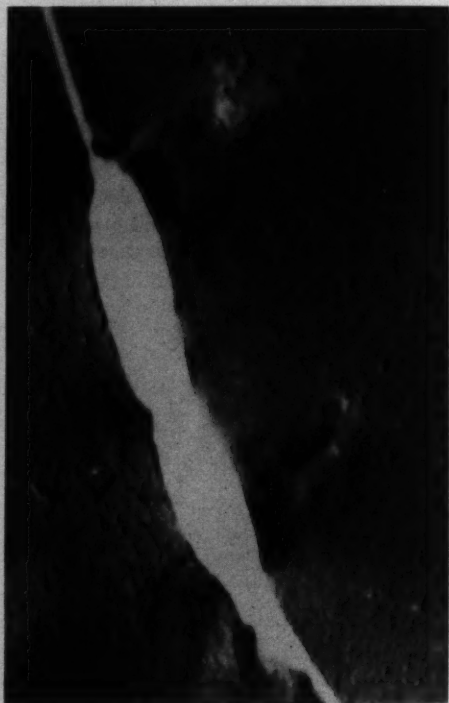


Fig. 10 (Taniguchi). Two cigar-shaped granules are hanging onto the same filament. (Platinum-shadowing, $\times 25,000$.)

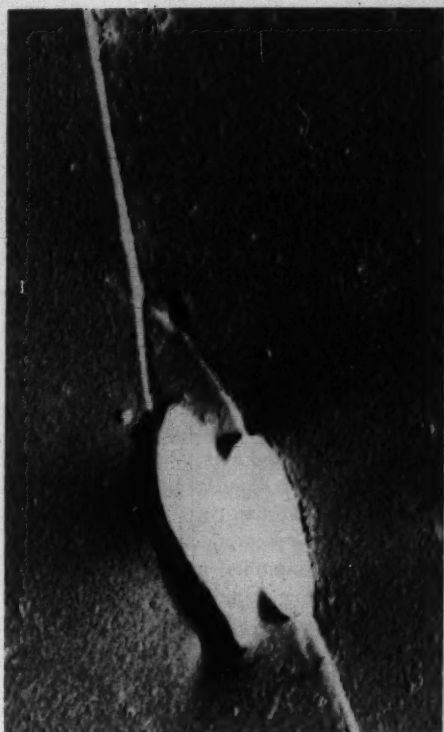


Fig. 11 (Taniguchi). One filament separates into two thinner ones and connects itself to each of two granules. (Platinum-shadowing, $\times 17,000$.)

filaments and granules are shown in Figures 9, 10, and 11. Usually the filament ran parallel to the major axis of the granule (figs. 9, 10, and 11), but occasionally not (fig. 12). The filament ordinarily appeared to connect two granules and to be attached only to the cigar-shaped type. Next to the granules these filaments became thinner and the contrast of the pictures was weakened.

The filamentous prolongations were two to 10 times the length of the pigment granules and had oblique striae like a twisted rope. The width of these filaments was from 0.06 to 0.08 μ .

DISCUSSION

In 1950 Sebruyns¹ examined for the first time pigment granules in the retinal pig-



Fig. 12 (Taniguchi). Three granules fastened to one filament. The lower filament separates at its upper end into two thinner ones. (Platinum-shadowing, $\times 21,000$.)

ment epithelium of the ox eye with the electron microscope at magnifications of 15,000 to 20,000 times. He observed that such pigment granules possessed a previously unobserved filamentous process at one extremity. Subsequently, others (François, Rabaey, and Vandermeerssche^{4,5}; Binder and Orth³; and Kinugasa⁶) failed to observe these filaments.

In regard to the form and size, Sebruyns said each granule was oval; whereas, Binder, *et al.*,³ found two types of granules; one was spindle-shaped with a length of 2.0 to 3.0 μ , the other one spherical with diameter of about 1.0 μ .

François, *et al.*,^{4,5} examined the pigment granules of the retinal epithelium of man, mammals, amphibians, and fish and stated that the pigment granules were characterized by polymorphism, the usual type being elongated with rounded extremities.

Kinugasa,⁶ studying the ox eye, reported that the pigment granules were spindle-

formed, ranging in length from 1.8 to 3.3 μ , and in width from 0.4 to 0.6 μ .

In a study of the pigment granules of the human eye, Takeuchi⁷ described an oval granule two to three μ in diameter and a globular one 1.0 μ in diameter.

In regard to internal structure, Sebruyns^{1,2} reported that each pigment granule of the retinal epithelium treated with chloramin-T was composed of several hundred microgranules contained in a sacciform membrane, but he did not describe the nature of the microgranules. Binder³ and Orth³ agreed with Sebruyns^{1,2} on the existence of many tiny irregular projections which suggested an internal structure. Near the surface of the spherical granule were seen tiny spherical grains about 50 $m\mu$ in size. François, et al., disagreed and stated that the pigment granules of the retinal epithelium were destroyed by chloramin, that their surface was irregular and scaly, but that they had no internal structure.

Recently, Iwaki⁶ reported on sections of retinal pigment epithelium, and, in the human being, described small particles of high-electron density packed in a less dense matrix in fuscine granules. In the bird and bat he found a fine tubular structure in the matrix in addition to the particles.

Sebruyns^{1,2} stated only that the internal structure was complex, and did not describe the nature of the microgranules.

Our pictures showed many tiny cigar-shaped, egg-shaped, and spherical forms, each microgranule assuming the shape of its parent. Having observed many tiny irregular projections on the surface of untreated granules, I tried to make the granules burst from their imprisoning sac by treatment with chloramin-T (four percent), ethyl alcohol in various dilutions, and by buffer solutions of varied pH. Only with 80-percent ethyl alcohol did the microgranules become apparent as though the membrane surrounding them had been destroyed. It was then observed that the microgranules assumed the cigar-, egg-, or

spherical shape of the parent granule. The length of the cigar-shaped microgranules was less than 0.2 μ , and the diameter of the spherical forms was less than 0.1 μ . The smallest observed length for ordinary cigar-shaped granules was 0.52 μ , and the smallest diameter of the spherical granules was 0.14 μ . Therefore, the size of the microgranules was just slightly smaller than that of the smallest ordinary granule.

Sebruyns^{1,2} claimed that each granule was oval and possessed a filamentous process four to eight times the length of the granule itself. He described the distal extremity as being free, varying in thickness from filament to filament, and possessing slack oblique striations. Later, Binder and Orth³ stated that such a filamentous process did not exist in the human eye. Kinugasa⁶ also denied such processes, but Takeuchi⁷ observed a filamentous process at one extremity of the granule of the human eye.

In the present studies, those granules which were treated with distilled water failed to show filaments (as noted by François, et al.^{4,5}). In contrast, those pigment epithelial cells treated with hypotonic solutions of saline or horse serum were found to have granules with filaments at one or both ends. It was found that washing the grid with distilled water in order to remove crystallized salt also removed the filaments. From these observations it was obvious that the filaments were fragile.

It might be, furthermore, that the conflicting results so far reported have been due to differences in procedure. To effect cytolysis, Sebruyns^{1,2} and Takeuchi⁷ used hypotonic saline; François, et al.^{4,5} distilled water; and Binder and Orth³ mechanical means. Of these, Sebruyns' method of cytolysis appeared superior because it produced less destruction of the pigment granules.

In the present experiment three agents were used to produce cytolysis: hypotonic saline, distilled water, and horse serum.

Horse serum seemed to be the best agent.

I found in this experiment that the thin filament is generally about five times the length of the granule with a width from 0.06 to 0.1 μ , and that it has oblique, spiral striae. These observations confirm those of Sebruyns. In addition to and at variance with Sebruyns, I found the filament divided into two thinner ones near its attachment to the granule, and it appeared to connect two granules and to run parallel to the axis of the granule. This seemed to indicate that the filament was a double helix formed by at least two thinner ones, and not a single twisted filament. This study also indicated that all of the granules which had filaments were cigar-shaped. Those granules which were egg-shaped or spherical had no filaments. It is thus possible that only the cigar-shaped forms are concerned in the migration of pigment granules.

It has been known that the pigment granules of the retina, when the retina is light adapted, migrate toward the rods and cones, and when it is dark adapted, they gather together at the outer base of the cells of the pigment epithelium. It has also been shown that this phenomenon is caused not only by light but also by various physical or chemical stimuli, these being no less effective than light.

It is commonly accepted that the pigment epithelial cells have, on their inner surface, a lot of protoplasmic projections which slip in between the rods and cones. The mechanism of movement of the pigment granules within these cells has led to a number of hypotheses. For example, Verne⁹ held that pigment cells may be truly amoeboid, and the peripheral processes have the property of retracting or expanding like the pseudopodia of amoebae.

A recent study by Uyama¹⁰ (1951) demonstrated that the pigment epithelial cells have conical pigment cones which fuse with the wall of the cone cells and with the external limiting membrane.

If this is true, and if they are connected with the external limiting membrane, it seems impossible for these projections to expand and contract freely like the pseudopodia of amoebae. Thus, the migration of pigment must be caused by movement of the granules themselves within the projections of the epithelium.

Sebruyns^{1,2} hypothesized that when the spiral of the filament is loosened, the granule migrates toward the external processes, and when it is tightened, it pulls back toward the base of the cell; thus, he felt it is from the expansion and contraction of the filaments that the migration of the pigment of the retina results. Takeuchi has supported Sebruyns' doctrine.

I would agree with Sebruyns that the filament is probably closely related to the migration of pigment granules, but I have a modified view about how the granules move inside the cell.

According to my observations, cigar-shaped pigment granules have a filamentous process at both extremities, except for the final pigment granules in a chain which have a filament at just their central extremity. Thus, a filament may connect two granules, and sometimes a central filament branches into two thinner ones. It is postulated that perhaps the pigment granules keep their positions by the strength of torsion and length of the filaments between the tip and the base inside the pigment epithelial cell.

Recently, Hanawa¹² studied the isolated amino acid in the pigment epithelial layer and stated that when the outer rod is exposed to light, the unknown photosensitive amino acid is activated. Therefore, on exposure to light, the chemical condition in the cell is changed, and it could be assumed that under this stimulus the filament on the inner side becomes more twisted, and perhaps the filament on the outside less twisted, so that the granule moves inward toward the more twisted filament.

Studies of thin sections of pigment epi-

thelium are under way to shed further light on this possibility.

CONCLUSION

An electron-microscope study of the pigment granules of the retina of the cow eye has led to the following observations:

1. The pigment granules assume a number of forms, usually cigar-shaped, but also egg-shaped and spherical, and occasionally irregular.

2. The granules are composed of a large number of microgranules with the same shape as the parent granules.

3. The varied size of pigment granules may be due to a difference in the size and number of microgranules they contain.

4. The cigar-shaped pigment granules have processlike filaments from one or both extremities which are two to 10 times the length of the pigment granule itself, and 0.06 to 0.1 μ wide.

5. The filaments appear to be composed of two strands, each of which is twisted like a rope. These filaments may possibly be active in the migration of pigment within the pigment epithelial cell perhaps by means of a twisting and untwisting of these filaments.

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I wish to express my appreciation for the kind advice of Dr. T. F. Schlaegel, Jr., in the pursuit of this study and in the preparation of the manuscript; to Dr. Roderick Turner for his assistance and advice with the electron microscope; and to Dr. Eugene Levitt for his statistical computations.

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SPECTRAL SENSITIVITY IN COLOR-DEFECTIVE SUBJECTS AND HETEROZYGOUS CARRIERS*

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INTRODUCTION

The slight sensitivity of protanopes to red light is generally known. In deuteranopes many investigators find a shift of the luminosity curve in the opposite direction. The increased relative sensitivity of deuteranopes to red rays is, however, doubted by others, since the luminosity curve of deuteranopes lies within the limits of spread found in normal persons.

For the theory of color disturbances and color vision in general it is of importance to find out whether the shift of the luminosity curve of deuteranopes is statistically significant. In this study the relative spectral sensitivity has been measured in 15 protanopes, 27 protanomals, 18 deuteranopes, and 53 deuteranomals.

Some writers have also found deviations in the luminosity curve among heterozygous carriers of color defects, especially among prot heterozygotes. The spectral sensitivity of heterozygotes was determined in 38 prot heterozygotes and 49 deuter heterozygotes. The control group of normal homo- and hemizygotes consisted of 54 persons.

METHOD

From 3,200 boys and 3,200 girls in Amsterdam schools, color-defective pupils were selected with the aid of Ishihara plates and a portable filter anomaloscope. The age of the children was between 13 and 17 years. It is beyond question that by this method practically all cases of defective color sense, even the lightest cases of anomalous color sense, were disclosed. No transition cases between normal and anomalous color vision were found in the examination with the anomaloscope nor any between normal and

protanomalous color vision. Six cases of low color discrimination with normal Rayleigh equation were omitted from consideration.

The color-defective boys and girls, together with their mothers, were asked to undergo an examination at the University Eye Hospital of Amsterdam. All the dichromats and protanomals were invited but only an unselected group of the deuteranomals. The largest part of those called responded to the request. The heterozygotes in this study are the mothers of the color-blind pupils, supplemented by several daughters of color-blind fathers.

The examination of the color-blind and the heterozygotes consisted of

1. Determination of the spectral sensitivity with a flicker photometer.
2. The customary diagnosis with the anomaloscope.
3. Examination with the Ishihara plates (11th ed.).

The control group comprised 34 males with no color-sense defects and 20 women with normal color vision, with no known color-sense disturbances in the family, and with at least one son with normal color vision. Even with these precautions it is not impossible that one or two heterozygotes may have strayed into the control group.

DETERMINATION OF THE SPECTRAL SENSITIVITY

Determination of a complete luminosity curve would have taken far too much time. Measurements were made of the ratio of the luminosity of green and red monochromatic light. The ratio

$$\frac{V(0.530 \mu)}{V(0.650 \mu)}$$

in the equal energy spectrum will henceforth be termed "luminosity quotient." The appa-

* From the University Eye Hospital.

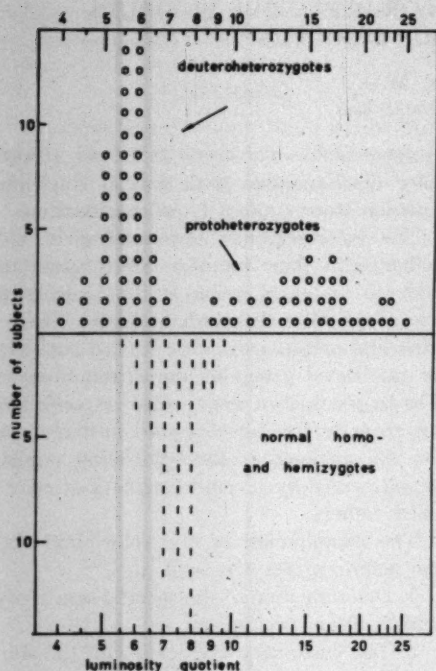


Fig. 1 (Crone). Luminosity quotient of normal and heterozygous subjects.

ratus used has been described in a previous article (Crone, 1955). The instrument was run at a constant voltage of 216 volts.

The test-field had a diameter of two degrees, with a black periphery. The brightness level was 25 photons. The laboratory itself was dimly lighted. The determination of a luminosity quotient required two adjustments: first a match between green and white light, then between red and white.

The brightness match between green and white light is accurate and easy since, if the adjustment is correct, the flickering reveals a fine minimum. In dichromats and anomalous persons with a strong color-sense disturbance the match between red and white light is also accurate but, among those with normal color vision and slight anomaly, it is more difficult since the minimum of flickering cannot be adjusted with equal fineness.

The controls were always worked by the investigator. If the observer error in a series of measurements exceeded ± 10 percent the observation was not recorded.

All the observations were made within a period of two months. During that period the luminosity quotient, in different measurements, was 7.8-8.2. The accuracy of the apparatus was undoubtedly sufficient for the purpose in hand. In view of the seasonal and mensural variations in the individual luminosity curves, exaggerated precision in the determinations would have been of little importance for this investigation (Dresler, 1941; Buchwald, 1941).

RESULTS

A. NORMAL SUBJECTS

The luminosity quotients of the control group are illustrated in Figure 1. The average normal value lies between seven and eight. For the C.I.E. standard luminosity curve the luminosity quotient is at 8.8. Were this standard curve to be shifted 5.0 m μ in the direction of the shorter wavelengths the

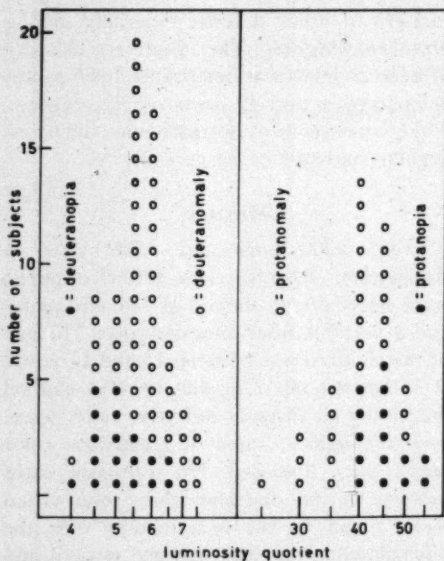


Fig. 2 (Crone). Luminosity quotient in defective color vision.

luminosity quotient would have been 11.2; in the direction of the long wavelengths 5.7. The spread in the maxima of the normal curves is, therefore, probably very small, not amounting to more than, at most, 10 m μ .

B. COLOR DEFECTIVE SUBJECTS

The luminosity quotients of the color-blind are illustrated in Figure 2. The deuterio-defectives and the proto-defectives each make up a homogeneous group. The extreme deviations from the normal luminosity quotient are to be found among the dichromats. Among the anomalous the deviation is, on the average, somewhat less. There is considerable overlapping between the luminosity quotients of deuteranomals and normals. Between the luminosity quotients of protanomals and normals there is no transition (nor were such transitions found in examination with the anomaloscope). Attention is drawn to the fact that the deuteranopes form a homogenous group. This investigation gives no support to the hypothesis that there are two kinds of deuteranopes differing from one another in regard to their spectral sensitivity.

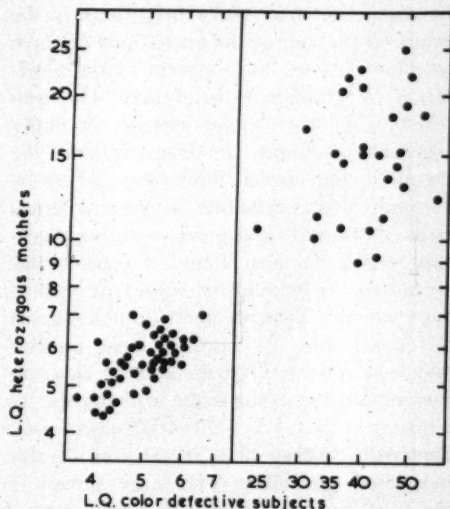


Fig. 3 (Crone). The relation between the color blind and their heterozygous mothers.

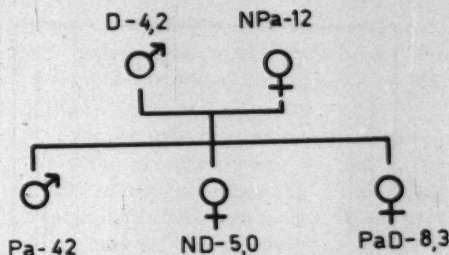


Fig. 4 (Crone). Pedigree of a presumably nonallelic compound heterozygote.

C. HETEROZYGOTES

The luminosity quotients of the heterozygotes are to be found in Figure 1. The average luminosity quotient of deuterio-heterozygotes is between 5.5 and 6.0, with relatively little spread. Among the proto-heterozygotes the spread is larger. The luminosity quotients of normals and deuterio-heterozygotes overlap considerably; neither is there any sharp demarcation between the luminosity quotients of normals and proto-heterozygotes. Among the deuterio-heterozygotes identification with the help of the luminosity quotient is possible in certain cases with some probability, among the proto-heterozygotes in most cases with a high degree of probability. Figure 3 shows the relation between the luminosity quotient of a color-blind pupil and that of his (heterozygous) mother. It appears that the luminosity quotient of a deuteranomal or a deuteranope is practically always lower than that of the mother. The deviations from this rule may very well be attributable to errors in observation. Generally speaking, the lower the luminosity quotient of the mother the lower the luminosity quotient of deuterio-defectives. As regards the proto-defects, it is also true that the luminosity quotient of the color-blind deviates more strongly from the normal luminosity quotient (has a higher value) than the luminosity quotient of the heterozygotes. There is less regularity among the proto-defectives; the mother of a protanope may have a practically normal luminosity quotient.

The pedigree in Figure 4 is particularly

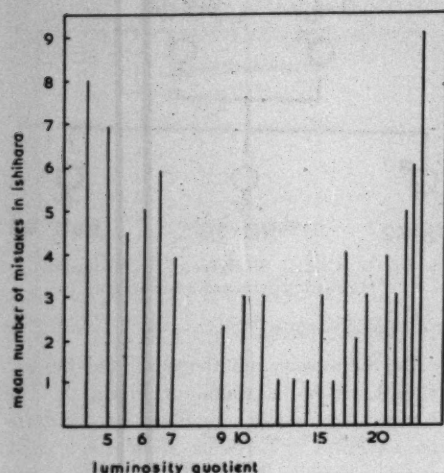


Fig. 5 (Crone). Relation between luminosity quotients and the average number of mistakes in reading the Ishihara plates.

interesting. A deuteranopic father and a mother with normal color vision have a protanomalous son and two normal daughters. The presumable genetic composition and the luminosity quotients are recorded between brackets. As the luminosity quotient of the youngest daughter is unusually high for an ordinary deuterio-heterozygote it is very probable that this daughter is a non-allelic compound heterozygote.

Rayleigh equation. This was normal in all the heterozygotes although in several cases a somewhat enlarged adjustment range was found.

Ishihara plates. During examination with the Ishihara plates a great many heterozygotes made a striking number of mistakes; 11 heterozygotes made more than eight mistakes, with a maximum of 13. Figure 5 shows the relation between the luminosity quotient and the average number of mistakes made in reading the Ishihara plates. The numbers are too small to justify a conclusion but it would seem that the more strongly the luminosity quotient deviates from normal the greater the number of mistakes.

DISCUSSION

A. LUMINOSITY CURVE AND COLOR BLINDNESS

The "shortening of the spectrum" on the red side in protanomals and protanopes has been recognized for a long time and is generally accepted. That deuteranopes have a relatively higher sensitivity to red rays is also to be found in the older literature (Polimanti, 1899; von Maltzew, 1909). In more recent times evidence has been published by Wright and his co-workers (Wright, 1946). The curves of protanomals and deuteranomals are to be found in Figure 6, taken from Judd (1943). Graham, Hsia, and Berger (1955) found decreased sensitivity for green and blue light in the deuteranopic eye in a case of unilateral deuteranopia.

De Vries, 1948, made extensive examinations with the flickerphotometer. He determined the brightness ratio of green (0.550μ) and red (0.654μ) light. For deuteranopes this ratio was 94/12, for protanopes 1,100/12. In normals it was found that the value ranged from 110/12 to 180/12. De Vries adopted the theory of Helmholtz. According to this theory brightness is the result of the sum of the excitations of three receptor systems. Each system makes a different contribution to brightness. The contribution of the "violet system" is either negligible or absent. De Vries explained the spread in the normal luminosity curves by the individual variations in the numerical ratio of the red- and green-sensitive receptors. Since we also found a considerable spread in the luminosity curves of dichromats our own measurements do not support this conclusion. It does not seem possible that this spread is attributable to observation mistakes or faults in the instruments. As a matter of fact, Pitt's curves of dichromatic luminosity curves also reveal considerable individual variability. The large spread in the course of the luminosity curves among normals raises doubt as to the increased red-

sensitivity of deuteranopes. Judd (1943) remarks: "The luminosity functions of deuteranopes fall well within normal limits but there is some indication that on the average they are higher than normal on the long-wave side." In Figure 6 he compares the data of Pitt with those of Gibson and Tyndall. The large span in the data of Gibson and Tyndall, as compared to my own data, is to be explained by differences in technique and also by the fact that these investigators did not exclude heterozygotes and observers with slight color defects.

Willmer (1949) is of the opinion that there are two kinds of deuteranopes:

Type I, with a normal luminosity curve. This would mean that the differentiation between the excitation of (normal) red and

green receptors would be lacking. This form of deuteranopia would thus be an "inner red-green blindness" in the sense of Müller (1924).

Type II, which is met with more often, lacks the green receptors, so that its luminosity curve is abnormal. This form of deuteranopia answers to the classic theory of Helmholtz. The deuteranopes of my own material were a homogeneous group so that I am not in a position to confirm the existence of the deuteranopia of Type I.

That the deuteranopes have an abnormal luminosity curve is entirely in accordance with the theory of Helmholtz but is difficult to accept by the followers of Hering's theory in its original form. According to the latter theory there can be only one red-green blind-

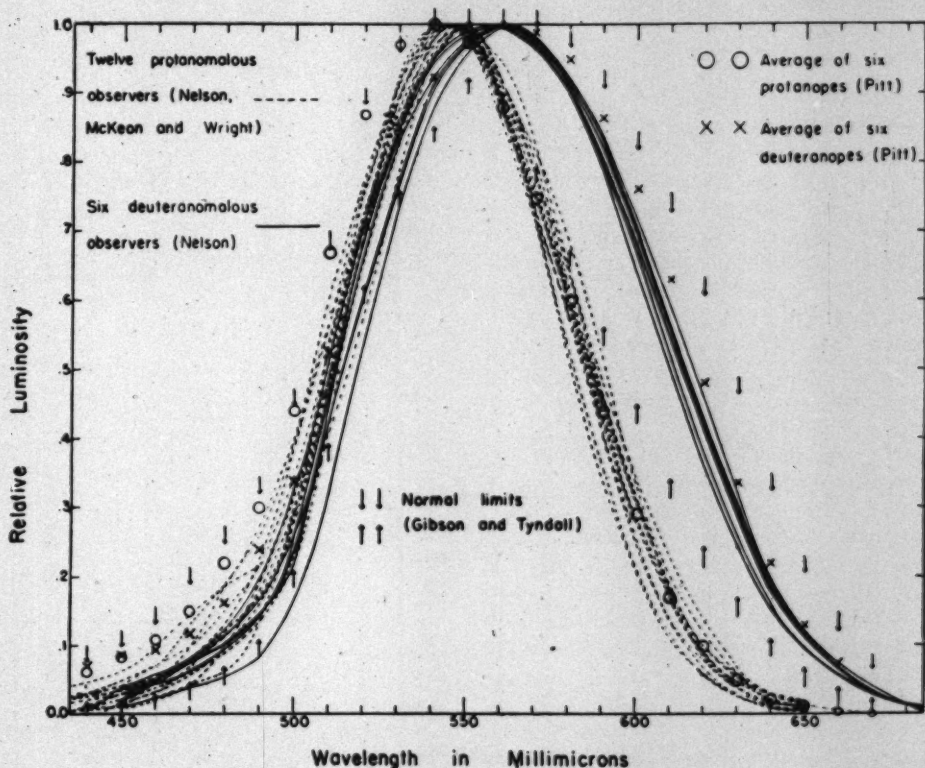


Fig. 6 (Crone). Luminosity curves (equal energy spectrum) according to the results of Gibson and Tyndall, Pitt, and Nelson, McKean, and Wright. (Judd, 1943.)

ness, caused by the falling-out of the "red-green process." Houston (1932, p. 201) goes very far when he regards even the luminosity curves of protanopes as normal variations. Others consider the "shortening of the spectrum," such as occurs in protodisturbances, as a separate and independent disorder.

Murray (1943) says: "Actually scoterythrous vision appears to overlie red-green blindness or weakness as astigmatism may overlie myopia or hypermetropia." This hypothesis is genetically untenable since proto- and deuterio-defects comprise two different series of multiple alleles; it is further disproved by the luminosity measurements of the present investigation.

B. THE LUMINOSITY CURVE IN HETEROZYGOTES

The color vision of heterozygotes has been frequently investigated. Waaler (1927) noticed that heterozygous girls often made mistakes in tests with the Ishihara plates. Wieland (1933) found a diminished discrimination of saturation differences among the heterozygotes. Individual cases of heterozygous women with manifest color disturbances have been described more than once (Schmidt, 1934; Brunner, 1930). Pickford (1951) also found among heterozygotes a lessened capacity for color discrimination in the red-green area, with no change in the Rayleigh equation.

It was Schmidt (1934) who made the important discovery that the luminosity curve of proto-heterozygotes is located between that of normals and that of individuals with proto-defects. Therewith she revealed a characteristic feature by which heterozygotes could be identified as such in spite of normal color vision. This characteristic feature appeared in all the 10 proto-heterozygotes she examined, while in nine deuterio-heterozygotes she could find no deviations in the luminosity curve. Walls and Mathews (1952) confirmed "Schmidt's sign" but noted that it was not always present. They too found

no abnormalities among the deuterio-heterozygotes. They did not use a flicker photometer however.

De Vries (1948) likewise studied the luminosity curve of heterozygotes. He found, in a small series of cases, that the luminosity curve of heterozygotes, also of the deuterio-defects, was situated between that of color-blind and normal subjects. He explained these findings by assuming that in proto-heterozygotes the red, and in deuterio-heterozygotes the green receptor system had a decreased sensitivity. He computed the numerical ratio between red and green receptors from the course of the luminosity curve.

My own material, which showed a wide spread in the luminosity curve of dichromats as well as of normals, permits of no calculation as to the quantitative decrease in sensitivity of the red or green system among heterozygotes. Even less would we dare compute a decrease in hue discrimination. That, nevertheless, a connection between the luminosity quotient and hue discrimination exists appears in Figure 5. That it was only in

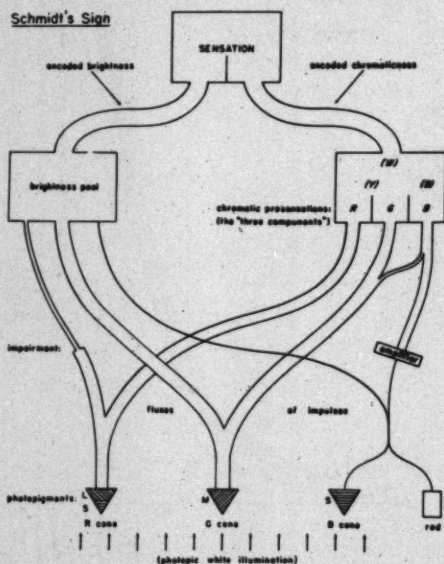


Fig. 7 (Crone). Schema to illustrate the phenomenon of Schmidt's sign. (Walls.)

cases with a strongly deviating luminosity quotient that the largest average number of mistakes were made with the Ishihara plates is in accordance with the idea that in heterozygotes one of the receptor systems must be less sensitive.

It remains however unexplained that color vision of heterozygotes always behaves as a "reduction system," that is, that the qualitatively changed sensitivity of the anomalous receptors does not become manifest in an abnormal adjustment of the anomaloscope.

Walls and Mathews (1952) and Walls (1955) also turned their attention to "Schmidt's sign." They assume that among the proto-heterozygotes it is only the luminosity component of the "red" system that is decreased, while the color component is maintained. Walls calls this the "branched pathway hypothesis" (fig. 7). In 1955 Schmidt adopted Wall's hypothesis.

The question remains whether there is any need for such a speculative hypothesis. In our opinion the abnormal luminosity curve found among the heterozygotes can best be

explained by a lowered sensitivity to the "red" or "green" system and we are therefore not inclined to abandon Helmholtz's theory. Only if a calculation were to show that in a given heterozygote a strong lowering of sensitivity of one of the systems would make inexplicable the remaining hue discrimination, would there be need for a new theory. So far, however, both the theoretical basis and the experimental data for such a calculation are lacking.

SUMMARY

Spectral sensitivity, measured by the luminosity ratio of red and green monochromatic light, was determined in 113 color-blind, 87 heterozygous, and 54 normal persons. The significance of the results of the measurements for the theory of color vision is discussed.

Wilhelmina Gasthuis.

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THE ISOLATION OF 21 STRAINS OF TYPE 8 ADENOVIRUS*

FROM AN OUTBREAK OF EPIDEMIC KERATOCONJUNCTIVITIS

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Jawetz, Kimura, Nicholas, Thygeson, and Hanna¹ in 1955 described a new type of adenovirus, subsequently shown to be type 8, which was isolated from a case of epidemic keratoconjunctivitis occurring in a sailor returning from the Orient. Additional data on serum specimens obtained from 1951 through 1955 in various outbreaks of epidemic keratoconjunctivitis showed agreement between presence of antibody against this virus and clinical evidence of the disease. Since then a number of further reports by some of their group²⁻⁴ and other investigators⁵⁻⁷ have shown an association between clinical epidemic keratoconjunctivitis and the recovery of type 8 adenovirus. However, other adenovirus types have been found in external eye infections.⁸⁻¹⁰ Moreover, the clinical differences between epidemic keratoconjunctivitis

and the conjunctivitis seen with other adenovirus types may be of little help in the sporadic case.

Commonly epidemic keratoconjunctivitis is limited to the eye. The disease is severe and preauricular lymphadenopathy, chemosis, and subsequently subepithelial corneal opacities occur with greater frequency than with other adenovirus types. Fever, sore throat, and other systemic signs are found in the younger aged individuals.⁴ The other adenovirus types associated with eye disease usually have more pronounced systemic signs and symptoms and rarely show corneal involvement. Here also, the only manifestation of the disease may be eye involvement. When this does happen, again, it appears to be seen more in adults. Consequently, the specific diagnosis is made in the laboratory although during epidemics the opportunities for diagnosing increase.

In the latter part of April, 1957, three cases of epidemic keratoconjunctivitis were seen in the eye clinic of the Los Angeles County General Hospital. In the ensuing weeks, a total of 58 cases accumulated. When it became apparent that an epidemic was in progress clinical and laboratory studies were undertaken. The clinical findings noted in

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this epidemic will be reported briefly. The other purpose of this report is to describe the isolation and identification of 21 strains of type 8 adenovirus recovered from the eye scrapings of tested individuals. Data on some characteristics of the isolates as well as tests on paired sera from cases of epidemic keratoconjunctivitis for complement-fixing and neutralizing antibody will be described.

MATERIALS AND METHODS

SUBJECTS

A total of 68 patients was included in the study. Fifty-eight of them had had clinical diagnoses of epidemic keratoconjunctivitis. The remaining 10 were clinic patients with unrelated problems; eye scrapings were obtained from nine of them; the 10th had paired serum specimens. The clinical diagnosis on the patients was not known until all laboratory studies were complete. The 58 who had epidemic keratoconjunctivitis were divided into clinical groups as follows: 42 who had enough clinical evidence to be classified as epidemic keratoconjunctivitis; 11 who had mild, short duration disease and were classified as mild epidemic keratoconjunctivitis; and five who developed the disease after contact with known cases of epidemic keratoconjunctivitis, and represented secondary cases. Reliable data on ages were available from 34 of the patients. They varied in age from 10 to 86 years with an elderly average of 65 years.

COLLECTION OF SPECIMENS

At the time of the first clinic visit, scrapings were obtained from the conjunctiva and suspended in nutrient solution. At the same time an acute blood specimen was obtained. Convalescent bloods were obtained approximately two weeks later. The majority of the acute specimens were obtained usually on the third day of illness. However, this was not always the case and, as shown below, a number of specimens were obtained late in the course of the disease. Furthermore, it was not possible to obtain second blood specimens on a

large number of the patients. From 33 of the patients with epidemic keratoconjunctivitis and nine others, eye scrapings were obtained. From 25 of the patients with epidemic keratoconjunctivitis paired serum specimens were obtained. However, only eight had eye scrapings and paired blood specimens.

All specimens were kept in test tubes tightly rubber stoppered and stored at -20°C . until used in tests. Eye scrapings were also cultured by usual laboratory procedures and microscopic examinations of cellular elements were carried out.

VIRUS STUDIES

The eye scrapings were initially inoculated into primary cultures of human amnion cells.¹¹ After washing three times with balanced salt solution, 0.2 ml. of the eye scrapings were inoculated into the culture tubes and incubated at 37°C . for one hour, then 0.8 ml. of nutrient media was added. Screw caps with rubber inserts were used to seal the tubes. Cells were examined microscopically every week day. The fluid was changed every five to seven days by drawing off 0.5 ml. and adding 0.5 ml. of fresh nutrient media to each tube. The nutrient media used prior to inoculation for growth of the amnion cell sheets was Parker's 199* solution, plus 10-percent horse serum. In some instances Eagle's basal nutrient media[†] was used, with 10-percent horse serum. After inoculation of the tubes, Parker's 199, plus two-percent horse serum, was added to give a total of 1.0 ml. of material. When destruction was complete 0.2 ml. of fluid was passed into fresh human amnion culture tubes or Chang's human conjunctival tissue culture¹² or HeLa cell culture tubes.¹³ Blind passages in primary human amnion cultures were

* Obtained from Microbiological Associates, Washington, D.C.

† Types 1 through 7 were obtained through the courtesy of Captain Seal and Lieut. C.D.R. Gundelfinger, Naval Medical Research Unit No. 4, Great Lakes Naval Training Station. Type 8 was obtained through the courtesy of Miss Hanna in Dr. Jawetz' laboratory.

made at intervals of time approximating two to five weeks from tubes where virus effect did not appear. Three such blind passages were carried out before a specimen was considered negative.

Virus was rapidly frozen and thawed before it was inoculated and this compared with the effect of the same virus which was not frozen. Comparison was also made between freezing and thawing and allowing the tubes to remain at 37°C. for one or more days beyond the time when a four-plus cytopathogenic effect was first seen. Varying quantities of virus fluid were added to the cells in an attempt to decide the optimum inoculum, and 0.2 ml. of fluid for one hour was found best. Every time passage was made of presumably virus-containing fluid, passage was made of equal quantities of control fluid into new control tubes.

TYPING OF VIRUS ISOLATES

Normal and immune rabbit sera prepared against types 1 through 8* adenoviruses were incubated at 56°C. for one-half hour. Undiluted virus fluid was added in equal volume to one to 20 dilution of serum. The mixture was incubated at room temperature for one hour and 0.2 ml. of the virus-serum mixture was added to test tubes containing human amnion, Chang's human conjunctiva, or HeLa cells. The HeLa and Chang's cell cultures were fed with lactalbumin hydrolysate-yeast extract nutrient media¹⁴ with 10-percent horse serum before and after the serum-virus mixture was added.

NEUTRALIZATION TESTS

Acute and convalescent sera from patients were inactivated at 56°C. for one half hour. One to five dilution was made of the acute blood specimens and one to five, one to 50, and one to 100 dilutions of the convalescent

specimens. Neutralizing effect was looked for by microscopic examination. In those instances where a neutralizing effect was observed with the acute specimen, further dilutions were made. The undiluted prototype virus recovered from one of the patients (Feldman) and shown to be type 8* was added in equal volume to the sera, and incubated at room temperature for one hour; 0.2 ml. of the virus-serum mixture was then added to either human amnion or Chang's human conjunctiva tubes. They were incubated for one hour at 37°C. and then 0.8 ml. of nutrient media was added. Two tubes of each dilution were then checked for cytopathogenic effect. In addition, tubes for serum control and virus control were included in each test. The tubes were kept at 37°C. for six to nine days and examined microscopically. In one test, fresh complement was added to the sera in a one to two dilution and the results were no different than when no complement was added.

COMPLEMENT-FIXATION TESTS

The first virus isolate which was shown to be type 8 (Feldman) was inoculated into large bottles containing Chang's cells and, when a four-plus effect was observed, the fluids were harvested and lightly centrifuged. The material was then diluted and used as antigen in a complement-fixation system containing two units of complement. The technique was a modification of that of Bengston.¹⁵ Complement was obtained fresh by bleeding guinea pigs. Box titrations with the Feldman sera were carried out and a one to four dilution of antigen used.

RESULTS

CLINICAL

On May 11, 1957, it became obvious that an epidemic of keratoconjunctivitis was occurring among the elderly patients constituting a portion of the population of the outpatient eye clinic at the Los Angeles County General Hospital. By checking the records of the patients, the first cases occurred on

* Miss Hanna in Dr. Jawetz' laboratory kindly confirmed this as being type 8 adenovirus. A generous supply of antiserum against Trim, the first type 8 adenovirus was also obtained from Miss Hanna.

the 25th and 29th of March. The peak occurred between the 10th and 20th of May. From the data shown in Figure 1 it appears likely that a continuing exposure of a number of the out-patient visitors occurred in the interval for April 25th through May 5th. The method of transmission was not clear but probably was by tonometer. The incubation period from exposure to onset of symptoms appeared to be between seven and 14 days with an average of 10 days.

The clinical findings on 58 of the cases are shown in Table 1 and, as can be seen, all of them showed conjunctivitis. However, only 20 of the 58 had clear evidence of subepithelial infiltrates. This is probably not a true representation since not all of the 58 returned at the proper interval of time in order to demonstrate subepithelial infiltrates. However, enough of them did return so that it was obvious that subepithelial infiltrates were being seen in less than 50 percent of the cases.

Preauricular adenopathy was only seen in a few of the cases and did not appear to be as common as has been noted by others.¹⁶ Chemosis was a common complaint and punctate keratitis was seen in 12 of 58. The finding of wrinkling of Descemet's membrane by use of the slitlamp indicated some internal inflammatory process in these cases. These data on the clinical findings confirm the variability already noted by other observers. Moreover, they emphasize the difficulty of making a purely clinical diagnosis.

The presence of previous disease in pa-

TABLE 1
EPIDEMIC KERATOCONJUNCTIVITIS CLINICAL FINDINGS

Conjunctivitis—	58/58	Chemosis—	56/58
Subepithelial infiltrates—	20/58	Punctate keratitis—	12/58
Preauricular lymphadenopathy—	7/58	Wrinkling of Descemet's membrane—	8/58

tients shown in Table 2 indicated that 20 of these individuals had glaucoma. Data regarding the influence of the epidemic keratoconjunctivitis on eye tension suggested that following the infection a decrease in tension occurred in the majority of these individuals.

The smears of the eye scrapings showed a predominance of epithelial and mononuclear cells. Quite a few also exhibited evidence of polymorphonuclear cellular response as well as considerable mucus and a few did show eosinophils. There was no evidence of inclusion bodies. The pattern of recovery of bacteria from eyes of the epidemic keratoconjunctivitis patients corresponded closely to the other types of cases being seen at the same time, suggesting that the bacteria seen in epidemic keratoconjunctivitis were not significant as an etiologic factor but represented secondary invaders recovered in a random fashion. Subsequent cultures of the eyes did become sterile since the majority of these people received some type of antibiotic despite the fact that it was obvious that this was an infection where antibiotics would not do anything except suppress secondary bacterial growth.

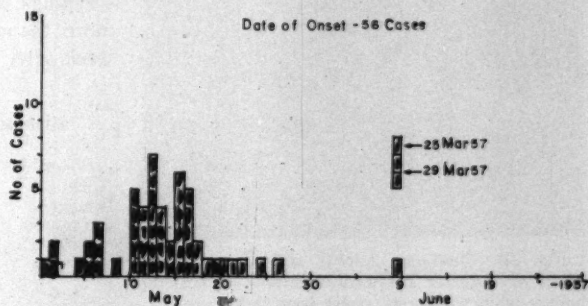


Fig. 1 (Quilligan, Adrian, and Alena). The number of individuals with epidemic keratoconjunctivitis plotted by date of onset.

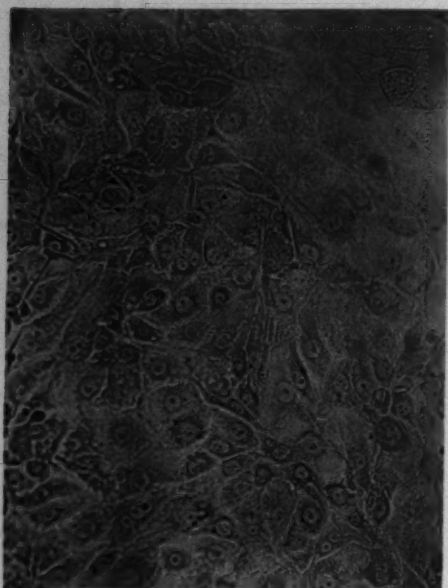


Fig. 2A (Quilligan, Adrian, and Alena). A normal human amnion culture (phase contrast).

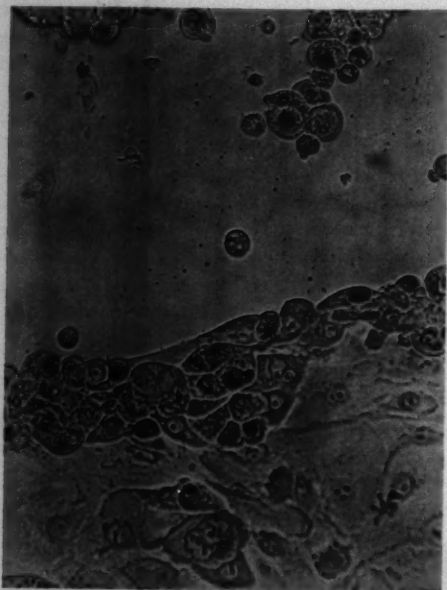


Fig. 2B (Quilligan, Adrian, and Alena). Early effect of epidemic keratoconjunctivitis on edge of human amnion culture (phase contrast).

VIRUS STUDIES

When the tissue cultures were inoculated with the eye scrapings, no cytopathogenic effect was observed for several days. The first signs appeared on the edge of the cell sheet. This is shown in Figure 2, phase-contrast pictures showing the dissecting effect of the virus on cells along the edge of the amnion sheet where the CPE was first observed and normal amnion for comparison. This action of the virus, being first observed at the edge of the sheet in the early passages of the eye scrapings, suggested that there must be some need for the glass-cell interface for penetration of the virus, although this was not studied in any detail.

These findings were noted in first passage somewhere between 14 and 40 days; soon after the virus would completely remove the cell sheet. On subsequent passage of these supernatant fluids from the primary tissue culture, the interval of time necessary for destruction of the cells sheet decreased as shown in Figure 3.

There was no difference when the virus fluid was frozen or refrigerated before inoculation, or the nutrient media was mixed with the virus for the primary passage. However, on subsequent passages of supernatant fluid containing virus, rapid freezing and thawing six times did increase the titer above that of untreated fluid.¹⁷

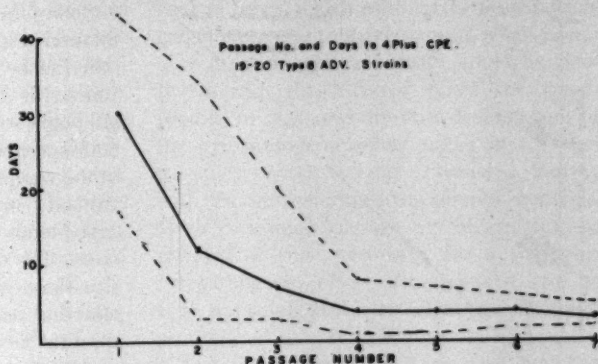
The results of recovery of virus from eye scrapings in 31 of the individuals are shown in Figure 4. All of the agents causing the cytopathogenic effect isolated from the eye scrapings were type 8 adenovirus. Furthermore, the majority were obtained within one week after onset. None was recovered from

TABLE 2
EPIDEMIC KERATOCONJUNCTIVITIS CASES:
PREVIOUS DISEASE

None	21	Conjunctivitis	2
Glaucoma	20	Diabetic	2
Refraction	8	Hypertension	1
Cataract	3	Sjögren's	1

Average age—65 yr.
34 patients—10 yr.—86 yr.

Fig. 3 (Quilligan, Adrian, and Alena). Interval of time necessary for a four-plus cytopathogenic effect to develop related to the tissue culture passage number with 20 type 8 adenovirus strains.



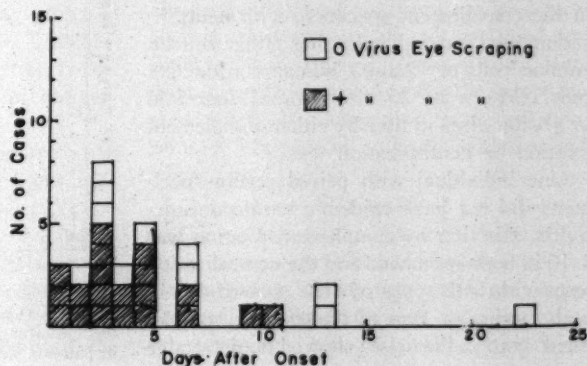
individuals sampled beyond 11 days after onset. None of the tests of the isolates with antisera against types 1 through 7 showed any neutralizing effect.

A few of the eye scrapings showed a ballooning of cells in the human amnion cultures. This was observed on the primary transfer of the eye scrapings but was not transmissible and was felt to be some toxic action on the cells by the material obtained from the eye. Most of the isolates showed complete neutralization of the cytopathogenic effect in the presence of the specific type 8 antiserum. However, in a few instances, on the fourth day, the virus would begin to show some effect on the cells in the presence of immune serum. This was because the undiluted virus fluid was used in the typing tests and with some of the isolates greater quantities of virus were inoculated. When

more dilute virus was used, the protective effect of type 8 antiserum was persistent.

When it became obvious that the virus was not growing to high titer in the tissue cultures, attempts were made to enhance the titer and one observation we noted was the better titers obtained from isolates incubated beyond the time a four-plus cytopathogenic effect was first seen. The type 8 adenovirus is a sturdy virus quite resistant to a number of physical effects³ and in this respect is similar to other adenovirus types.¹⁸ The fluids from two isolates were kept at 37°C. for intervals of two to four days after all the cells had detached from the tube and showed four-fold or higher titers than fluids removed just at the time the four-plus cytopathogenic effect was first observed. When the tubes were kept for eight to 14 days after the four-plus cytopathogenic effect and then titrated, a

Fig. 4 (Quilligan, Adrian, and Alena). Association between the ability to recover type 8 adenovirus and time interval from onset to collection of specimens.



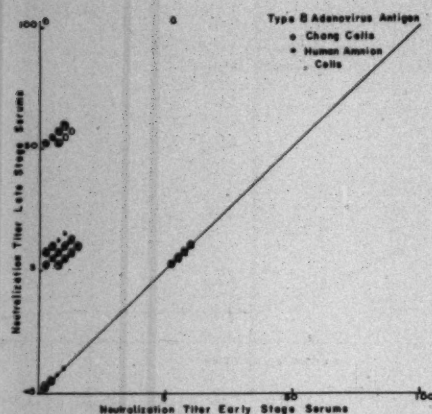


Fig. 5 (Quilligan, Adrian, and Alena). Paired serum specimens tested for neutralizing antibody against type 8 adenovirus with Chang's human conjunctiva cells or primary human amnion cells.

decrease was observed but even under these circumstances titers of 1:4 or 1:8 were found. It appears that allowing the cells to remain in the incubator for an additional one to two days after the four-plus cytopathogenic effect occurs will release more virus from the cells. Freezing and thawing did not give as good titers.

The results of the antibody tests are shown in Figures 5 and 6. The titers in the convalescent sera showed good agreement between the complement-fixation and neutralization tests, although the dilutions used were not the same. Fifteen of 25 patients showing rises in their convalescent specimens by the complement fixation test, also showed rises in the convalescent specimen, with neutralization tests carried out using either human amnion cells or Chang's human conjunctiva cells. Fifteen of 25 also showed four-fold or greater rises in titer by either complement fixation or neutralization test.

One individual with paired serum specimens did not have epidemic keratoconjunctivitis. His titer by complement fixation was 1:16 in both specimens and the neutralization tests with both types of cells showed 1:5 in both specimens. Five of the tests for complement fixation titer rises showed no detectable

antibody in either specimens. Complement fixation tests on over 50 pairs of sera from individuals not having epidemic keratoconjunctivitis showed none with a rise in titer although some of them had high titers in both specimens. Two of the four individuals in the complement fixation tests who showed antibody in both serum specimens had the first bloods drawn seven and 16 days after onset. The other two individuals represented situations where the date of onset was not clear but probably at least seven days before the first blood was drawn.

As can be seen in Figure 5, a few individuals gave higher titers in their convalescent specimens with Chang's cells than with human amnion cells. There were three individuals who showed presence of neutralizing antibody but no rise in titer; the first serum specimen was obtained seven days or more after onset in all of them. Two, or four, of the neutralization tests, depending on whether the test was carried out in Chang's or human amnion, showed no detectable antibody.

DISCUSSION

The literature on epidemic keratoconjunctivitis prior to the studies of Jawetz, et al.,

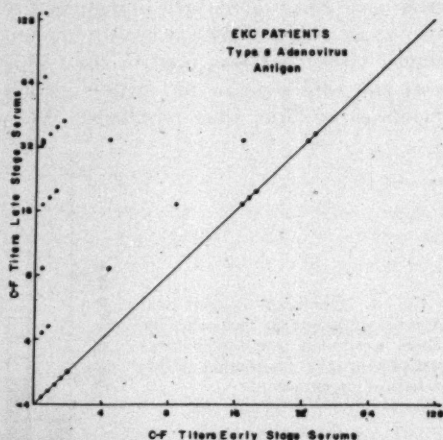


Fig. 6 (Quilligan, Adrian, and Alena). Complement fixation titers using type 8 adenovirus antigen in patients with epidemic keratoconjunctivitis.

has been reviewed by Cheever and some of the concepts of the etiology of epidemic keratoconjunctivitis clearly discussed.¹⁹ Furthermore, recent studies mentioned above, including our present report, showed the clear etiologic association of type 8 adenovirus with epidemic keratoconjunctivitis. Moreover, the part other adenovirus types play in conjunctivitis, especially in children, has done much to clarify one segment of superficial eye infections.

The frequent recovery of type 8 adenovirus from Japanese cases⁸ of epidemic keratoconjunctivitis has clearly demonstrated the foothold this virus has in Japan. In this respect the almost unanimous feeling that the virus only penetrates the eye after some trauma; coupled with the known ability of the virus to withstand heat without complete loss of infectivity, suggests that local customs, such as public baths, may contribute to virus dissemination in Japan. In this country, the other adenovirus types have been associated with epidemics initiated in swimming pools.¹⁰

The majority of our patients were elderly; however, there were two children and one 22-year-old adult. None of these young individuals developed subepithelial infiltrates of the cornea and one of them did have fever and sore throat. These findings are in accord with Mitsui⁸ who found that the young individuals were more prone to develop systemic effects and the older individuals only local eye involvement. This age difference could conceivably be due to a limiting effect of antibody to other adenovirus types. Furthermore, the development of opacities in the cornea may also be related to an antigen-antibody reaction.

Our early attempts at isolating the virus from eye scrapings were carried out with HeLa or Chang's conjunctival cells. We experienced difficulties because the cytopathogenic effect was late in developing and was difficult to differentiate from changes occurring in the control tubes. However, when primary human amnion cells were used, the

control tubes, which continue to show normal growth for one to three months when necessary fluid changes are made, could be compared with the infected tubes for longer periods of time and the slow development of the cytopathogenic effect noted in the first passages of the isolates contrasted sharply with the normal-appearing amnion controls. With continued passage of the isolates the interval of time necessary for a four-plus cytopathogenic effect decreased to two to four days and HeLa or Chang's cells could be used.

The resistance of the type 8 to heat has been shown by Hanna, et al.,³ and this characteristic was utilized in attempting to get a better yield of virus from the isolates. When we allowed the tubes to remain in the incubator 48 hours beyond the time that a four-plus cytopathogenic effect was observed, the titer would increase four-fold in most instances. An alternative procedure was to freeze and thaw six times as recommended by Ginsberg;¹⁷ however, the titers were not as good with this procedure as when we allowed the tubes to remain in the incubator longer.

Tests of the paired serum specimens for the presence of neutralizing antibodies against types 1 through 6 of the adenovirus group are in progress. Our attempts to utilize the pH color change test²⁰ for the determination have not been entirely successful. Clear-cut acid changes occur with types 1 through 6 and satisfactory neutralization of the acid changes with specific antisera can be demonstrated. However, we do not get good acid changes with type 8. Consequently, tube dilutions with observation for the cytopathogenic effect are being used in testing these sera for presence of antibody against type 8 adenovirus.

SUMMARY

There was a total of 68 individuals in this study group, and 58 had epidemic keratoconjunctivitis. Thirty-three had eye scrapings and an additional nine individuals had eye scrapings but did not have epidemic

keratoconjunctivitis. No isolations of virus were made from these latter nine patients. However, type 8 adenovirus was isolated from 21 of the 33 patients with epidemic keratoconjunctivitis. Twenty-five individuals with epidemic keratoconjunctivitis had paired serum specimens and 15 showed four-fold or greater increases in titer of convalescent spec-

imens against type 8 adenovirus in either complement fixation or neutralization test. The striking association of clinical epidemic keratoconjunctivitis and isolation of type 8 adenovirus reported here reinforces the concept of this virus as an etiologic agent.

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NOTES, CASES, INSTRUMENTS

IMPROMPTU COSMETIC LENS OCCLUSION*

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In the treatment of ocular nerve palsies the one immediately effective method to remove the discomfort of diplopia is occlusion of the paretic eye. Among the occlusive materials available the best so far is the recently developed 1.5-inch width Band-Aid Clear Tape (Johnson & Johnson). This plastic tape comes in five-yard rolls and is obtainable from surgical supply houses.

After the determination of the paretic muscle, the clear tape is applied to the inner surface of the spectacle lens covering the involved eye. It is rubbed on firmly so as to be closely adherent to the glass. When the spectacles are now worn, the eye and the ocular area can be seen through the clear tape but the eye behind it sees practically nothing. Vision is reduced to the bare recognition of fingers at three inches or to about 0.001 in the decimal scale. The cosmetic effect is similar to that of the Chavasse glass but the clear tape is immediately effective and saves the patient a trip to the optical dispenser and added expense. Moreover, the extent of the covered area can be manipulated at will. Following a period of total occlusion the covering can be limited to just the area of the lens in the field of action of the involved muscle. For example, in right abducens palsy occlusion may be reduced to the lateral two fifths of the right lens, thus allowing a considerable range of binocular vision for both far and near.

In applying the tape for total occlusion a pattern of the lens is first prepared. A square of paper, clipped to the outer surface of the spectacle lens to be covered, is held toward

the light and the transilluminated outline of the lens is traced with a soft pencil or ball-point pen.[†] The top and nasal sides are labelled. The cut-out pattern is then applied to the nonadhesive side of the clear tape, keeping the lower edges flush with each other. Lenses usually vary in size from 32 by 40 to 38 by 46 mm. In lenses wider than 38 mm., the tape can be stretched somewhat which adds to its cosmetic quality, or the uncovered space above is covered by an additional strip.

The covering is long lasting. However, the lens can be restored quickly to its original status at any time by peeling off the tape and removing the adhesive residue with cleaning fluid.

This clear tape is equally advantageous for the occlusion of the better eye in suppression amblyopia. In sequential treatment the tape is removed from the better eye and the lens over the suppressing eye is semioccluded—the nasal half in an exotropic proclivity,¹ the temporal half in an esotropic tendency.²

This clear plastic tape is also made in smaller widths, 1/2 and 13/16 inches. The half-inch width, now available in all drug-stores, is dispensed in a handy container with a snipping device. By its use the cosmetic appearance of eye dressings is enhanced, as the clear tape is invisible on the skin and is waterproof. As compared to Scotch tape, this plastic tape is sturdier, more flexible, more elastic and more adhesive. The side of the nose is occasionally eroded by spectacles, a condition which may persist in spite of repeated adjustments. The placing of a small patch of the invisible tape over the eroded area immediately relieves the irritation and permits the glasses to be worn comfortably. After several days, the skin heals sufficiently

[†] In lenses of asymmetric outline, such as the Harlequin type, the outline should be traced over the lens that is not to be covered. When the cut-out pattern of the plastic tape is then laterally reversed, the adhesive side will accurately fit the lens of the involved eye.

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so that the tape can be removed without renewal of discomfort. This clear plastic tape is likewise an acceptable and serviceable

measure for the temporary relief of spastic entropion.

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MUSCLE TRANSPLANTATION

FOR EXTERNAL RECTUS PARALYSIS

REPORT OF CASE WITH UNUSUAL COMPLICATIONS

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Since Hummelsheim,¹ in 1907, first suggested transplantation of the lateral halves of the tendons of the two vertical recti into the region of the insertion of a paralyzed lateral rectus to enhance its action, his technique, with many modifications, has been employed in the treatment of paralysis of the sixth nerve. Recession of the medial rectus and resection of the paralyzed lateral rectus, now usually performed, were incorporated into the operation as a later development.² A particularly noteworthy modification was reported by O'Connor,³ who transplanted the nasal halves laterally instead of the temporal halves of the vertical recti. To this procedure Berens and Girard⁴ added transplantation of the nasal tendon halves to the temporal portions of the original insertions, and Krewson² further modified their procedure by attaching both medial and lateral tendon slips lateral to the original insertions.

My experience with this operation has been limited to 17 eyes in 15 patients. It has been my practice first to perform a recession of the internal rectus and then to resect the external rectus, split the superior and inferior recti about 15 mm. back from their points of insertion and attach the temporal halves to the resected external rectus at its scleral insertion. The operation has been performed in one stage. In bilateral

external rectus paralysis an interval of one week to 10 days elapsed between the operation on the first eye and that on the second. In 16 of the 17 eyes the operation was uneventful, but in the 16th eye unusual complications developed.

REPORT OF CASE

A white man, aged 24 years, first consulted me on January 31, 1958. He had been struck on the left ear by a piece of metal in an explosion of the engine of a fishing boat on December 21, 1957, and had been advised that there was some damage to the eighth nerve on the left side.

Examination showed complete paralysis of the sixth nerve on the left side and an extreme contraction of the antagonist with 35 prism diopters of internal deviation. On effort to look to the left there was no tendency to any lateral movement even approaching the midline. The uncorrected distance vision was 20/20 plus in the right eye, and 20/30 plus in the left eye with eccentric fixation in this eye. The eyegrounds and media were normal in appearance, and the peripheral and central field studies gave negative results.

In spite of the recent date of the trauma, it was decided to operate on the left eye, attacking the four muscles in a one stage procedure. At operation on February 5, 1958, the first step was a recession of the internal rectus of 4.5 mm. Successive steps were a 10-mm. resection of the lateral rectus, splitting the superior and inferior recti about 15 mm., and transplanting the temporal halves to the resected external rectus in the region of the scleral attachment. The entire procedure was carried out uneventfully.

Both eyes were padded and not dressed for 96 hours. At the first dressing, the left eye was not particularly red, but a striate keratitis and an immobile pupil could be observed. Nine days after the operation, examination in my office showed a striped keratitis involving particularly Descemet's membrane. Six days later, the cornea was clearing, but the pupil was elliptical with the pupillary defect on the lower temporal side. There were some clumped whitish masses on the anterior capsule of the lens, but no aqueous flare or keratic precipitates were present.

A rather high compound myopic astigmatism developed in this eye with a corrected vision at one



Fig. 1 (Forbes). Eccentric pupil of operated left eye. Defect to lower temporal side.



Fig. 2 (Forbes). Excellent postoperative lateral movement of affected left eye.

time of not more than 20/200 plus. Efforts were made to eliminate any posterior synechias, should they be present, with subconjunctival homatropine and Neosynephrine, alternated with instillations of Floropryl. One month after the operation the corrected vision was only 20/200 plus. Two months postoperatively, however, it was 20/30. The myopia lessened, decreasing from four diopters to two diopters four months postoperatively. The muscle result was excellent with eventually four prism diopters of esophoria at distance and two to three diopters of exophoria at near with normal distance and near vertical muscle balance and binocular single vision at both distance and near. The motility was very good with an excellent abduction in the operated eye resulting.

Figure 1 shows the eccentric pupil in the affected eye, and Figure 2 shows left lateral rotation with excellent movement of the paretic eye. Figure 3 illustrates the postoperative eye movements. The iris and consequently the pupillary pattern improved considerably. There remained only a little eccentricity of the pupil and slight trophic changes of the iris to the lower temporal side of a heterochromic pattern with some stromal atrophy.

DISCUSSION

In an effort to analyze the complications in this case, I consulted with one of the coun-

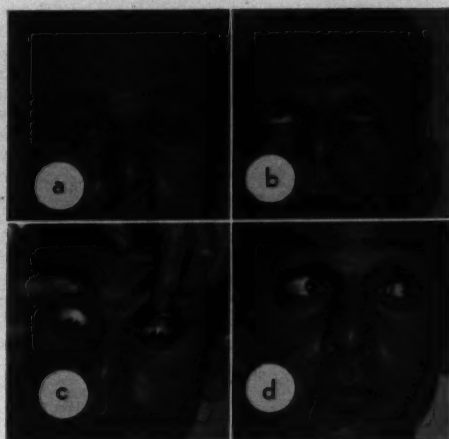


Fig. 3 (Forbes). Postoperative eye movements (a) in the primary position, (b) on elevation, (c) on depression, and (d) on left lateral rotation.

try's most eminent ocular myologists, who was as completely at a loss as I was to explain what had happened. The patient saw the head of one of the large eye institutions in the East, who pronounced the operative result excellent, but stated that he did not know what caused the irregular pupil.

Stucchi and Bianchi,⁸ in 1957, reported observing similar complications in four cases of muscle transplantation for posttraumatic paralysis of the sixth nerve. Their operation consisted of anastomosis of the lateral portion of the vertical recti at the insertion of the previously resected external rectus, followed by recession of the internal rectus, a technique almost identical with mine. Three to 10 days postoperatively, a subacute "iridocyclitis" developed, with a Tyndall phenomenon and numerous circulating cells. The duration of this uveal reaction ranged from eight to 30 days. The rapidly pigmented cells were deposited on the corneal endothelium, especially that corresponding to the temporal portion of the iris, which gradually became depigmented. The pupil became deformed, even in cases without posterior synechias. These authors attributed this anomaly to involvement of the stroma. In their opinion, the iritis was due to ischemia since, in per-

forming the muscle transplantations, the iris was deprived of blood supply from the anterior ciliary arteries. They also stated that atrophic heterochromia, which was present in my case, has a vascular cause and observed further that, experimentally and clinically, ischemia of a particular retinoveal region is followed by atrophy and pigment changes, proportional to the circulatory deficit.

The question arises as to the advisability of performing the operation in multiple stages. Would it perhaps be well to perform a recession of the internal rectus as a preliminary stage, to be followed later by the attack on the external, superior and inferior recti? Stucchi and Bianchi⁵ questioned whether depigmentation of the iris is attributable to surgical attack on three muscles in a single procedure, with transplantation of the temporal portion of the vertical recti suppressing the tributary irrigation of the anterior ciliary arteries, thus interfering with the collateral supply of the iris. At the same time, they wondered why other authors who operate on three or four muscles in one stage have never described similar iris depigmentation. They reasoned that if iris depigmentation is of ischemic origin, it would seem logical to attempt to assure sufficient nutrition of the iris by transplanting the nasal half of the vertical recti in a preliminary stage, as some authors advocate, and then to perform the recession of the internal rectus in a second stage, to allow collateral circulation to develop. They noted that Hartmann⁶ also advised that no more than two rectus muscles should be operated on at the same procedure.

Krewson² preferred to recess the medial rectus and then to resect the paralytic lateral rectus at separate sittings. If sufficient correction was not obtained by these surgical measures, transplantation was undertaken at a later date. Riffenburgh⁷ reported a case of bilateral external rectus paralysis in which he performed bilateral muscle transplantation more than two years after resection of the lateral recti and, seven weeks later, re-

cession of the medial recti had been performed elsewhere. The one stage operation of Berens and Girard⁴ included retroplacement of the medial rectus, resection of the lateral rectus, transplantation of the lateral halves of the superior and inferior recti with Tenon's capsule to the lateral rectus insertion and, in addition, transplantation of the medial halves of the superior and inferior recti temporally to the vertical meridian. Rønne⁸ favored the four muscle approach in a one stage operation.

In my opinion, the results of muscle transplantation will be considerably better if a one stage procedure is carried out, beginning with the attack on the probably contracted internal antagonist and continuing with resection of the lateral rectus, followed by transplanting the halves of the superior and inferior recti to the resected external rectus at its scleral insertion. In this case a remarkable degree of abduction was obtained, which may have been due to the recent date of the injury with some spontaneous improvement in the function of the involved sixth nerve. The contraction of the antagonist, however, was of greater degree in this case than in any case of the series irrespective of the time elapsing from the date of injury. Rønne⁸ concluded that early operation is not contraindicated in cases of this type and found the results in his series nearly identical whether operation was performed early or late.

My preference is for the one stage modified Hummelsheim operation. In adhering to this procedure, however, one should realize that in a very small percentage of cases there is the possibility of ischemia of the anterior uveal tract and apparently resultant changes of a permanent nature such as anisocoria, atrophic heterochromia and iris depigmentation. The irregular pupil was the patient's chief complaint in my case.

SUMMARY

A series of cases is reported in which muscle transplantation for paralysis of the external rectus was performed on 17 eyes

in 15 patients. In one case, which is described, unusual complications included an elliptical pupil.

The advisability of a one stage or multiple stage operation is discussed. It is concluded that the one stage modified Hummelsheim procedure is to be preferred, but with the realization that rarely a deformed pupil and other permanent changes may ensue.

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ADDENDUM

Since this paper was submitted for publication, a case of muscle tropia secondary to thyrotropic dis-

ease has come under my care, in which the exophthalmos was so severe that orbital decompression was necessary. Much later, a successful attack from the standpoint of ocular function on the four rectus muscles was followed by sequelae in lesser degree similar to those in the case here reported. There were white deposits on the anterior surface of the lens, an irregular pupil, and eventually a sector iris defect. Later, it became necessary to operate again on one of the vertical muscles, apparently with no resultant involvement of the uvea. Recently, Girard and Neely (Agnesis of the medial rectus muscle. *Arch. Ophth.*, **59**:337-341 [Mar.] 1958) mentioned performing muscle transplantation operations on two adults, with attack on the four rectus muscles, which were followed by severe keratitis, iridocyclitis, necrosis of the iris, and secondary cataract.

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INSPECTION CLAMP FOR KERATOPLASTY INSTRUMENTS

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The margin of error in keratoplasty is small and to obtain a higher percentage of successful grafts, the following prerequisites should be recognized: (1) Proper selection of cases, (2) flawless surgical instruments, (3) suitable donor material.

A recipient cornea that presents controlled inflammatory reaction, a minimal degree of vascularization, and a fairly healthy periphery is known to give better results in corneal transplantation.

Minute attention to details as it pertains to the use of ultrasharp instruments cannot be overstressed. The trephine, the corneal scissors, and the corneal needle rate respec-

tively in importance. Their cutting edges should be flawless and they must be carefully examined under the low-power microscope for defects before attempting any keratoplasty.

The donor eye gives the best results when removed within two hours after death, and



Fig. 1 (Rizzuti). Both sides of the instrument clamp used for instrument inspection.



Fig. 2 (Rizzuti). Inspection clamp set up for study of donor eye and keratoplasty instruments.



Fig. 3 (Rizzuti). Inspection clamp holding donor eye for slitlamp examination.

immediately placed in the proper moisture chamber which is refrigerated at 3-4°C. When feasible, the cornea should be used for grafting preferably within 48 hours. Before attempting keratoplasty it is imperative that a careful slitlamp study be conducted. The cornea should be discarded if it presents marked structural deformities, stromal infiltration, and endothelial changes (Fuchs' dystrophy) or precipitates. Tumors of the anterior ocular segment make clear corneas unusable. Eyes are acceptable, however, that show denuded epithelium or a moderate striate keratitis (edema) as a result of refrigeration.

To inspect keratoplasty instruments and for slitlamp study of donor eyes, a special instrument clamp has been devised.* It con-

sists of a base that can be clamped to any current model slitlamp and has two extension arms that are movable on universal ball joints. One arm has an alligator clasp for holding a keratoplasty trephine, scissors, and so forth, for inspection under the low-power microscope. Any defects of the cutting edges can be easily detected. The second extension arm has an open circular flexible ring to support the neck of a small glass-jar moisture chamber containing the donor eye. Microscopic examination of the cornea is thereby easily accomplished with this particular instrument "set up."†

160 Henry Street (1).

† Used in Corneal Clinic, Brooklyn Eye and Ear Hospital.

LAMELLAR KERATOPLASTY*

FOR TRAUMATIC NECROTIZING
CORNEAL PERFORATION

MERRILL GRAYSON, M.D.
Indianapolis, Indiana

Patients with perforated corneal ulcers now may be able to obtain a serviceable eye through either lamellar or penetrating keratoplasty. Before this was possible, many lost eyes as a result of panophthalmitis, endophthalmitis, and/or complicating secondary glaucoma. Those eyes not lost exhibited dense scars and were optically and aesthetically poor.

Lamellar keratoplasty is technically safer and seems preferable to penetrating keratoplasty in children, monocular cases, aphakia, nystagmus, superficial opacities of the cornea, recurrent ulcerations of the cornea, such as herpetic ulcers, dystrophies, and descemetocoele, and in extremely "nervous" persons who may be difficult to control post-

* This instrument may be obtained from the Storz Instrument Company, 4570 Audubon Avenue, Saint Louis 10, Missouri.

* From the Department of Ophthalmology, Indiana University School of Medicine.

operatively. It is generally known, of course, that the visual-optical results are not so dramatic or satisfactory as those with penetrating keratoplasty. Hogan,¹ Taylor,² and Paton³ have used a penetrating keratoplasty for the treatment of perforated corneal ulcers. However, it seemed more advisable in the particular instance which will be described to chance lamellar keratoplasty.

There are a number of difficulties that are encountered in accomplishing a lamellar keratoplasty on a cornea that has undergone a necrotizing perforation. It should be emphasized that a condition of this particular nature is a surgical emergency and requires judicious heroic measures. Timidity has no place since all is lost if a keratoplasty, either lamellar or penetrating, is not performed.

CASE REPORT

R. L., a nine-year-old white farm boy with blue irises, first was seen in the Ophthalmology Clinic of Indiana University School of Medicine on November 7, 1957, having been brought in by his parents for examination of his left eye which, according to the obtainable history, suffered a supposedly mild injury on November 1, 1957. The inciting factor, in so far as could be determined, was a field cocklebur on which the boy had fallen. He apparently received home treatment in the form of argyrol; the preparation and the concentration of this agent were undeterminable. The argyrol was instilled a number of times daily for one week following his accident. The symptomatology was confined to moderate photophobia of the left eye and to a redness of that eye that became noticeable to his deaf-mute mother.

Examination of the left eye (fig. 1) revealed a lesion which was essentially apical in location and two mm. in diameter. This lesion was whitish-yellow in color and extended deep into the corneal stroma and was surrounded by a faintly visible halo of infiltration which was made out by examination with the biomicroscope. In addition to the central lesion there was a moderate epithelial imbibition noted. On the first examination this necrotic mass was continuous with the normal plane of the cornea externally. It was the opinion of the staff that this was a corneal abscess of undetermined etiology, initially traumatic in nature which became secondarily infected. Examination of his right eye did not reveal any pathology. Accordingly, the boy was admitted to the James W. Riley Hospital.

Cultures revealed gram-positive cocci in pairs sensitive to penicillin and Chloromycetin. The boy was treated with subconjunctival injections of penicillin and systemic Chloromycetin (200 mg. every



Fig. 1 (Grayson). Appearance of the left eye on admission to the hospital. The central necrotic mass extended through all layers of the cornea. This area became enlarged while the patient was in the hospital.

six hours). One-percent atropine and 10 percent Neo-synephrine drops were used for mydriasis.

On November 14, 1957, it was noted on biomicroscopic examination that the apical area of the cornea was bulging slightly and it was now thought that a descemetocoele was present. Diamox (125 mg. every six hours) was added to the medical regime. The systemic Chloromycetin and subconjunctival injections were not visibly aiding the corneal ulcer, and the patient was becoming increasingly more uncomfortable and exhibited intensive photophobia of the left eye, with some question of sympathizing irritation of the right eye.

In view of the poor response to chemotherapy, a mycotic infection of the cornea was suspected but this was not substantiated by cultures and smears.

On November 20, 1957, a hypopyon was noted for the first time and this extended 0.5 mm. above the limbus. The hypopyon, however, disappeared before the surgery was performed.

Retrogression slowly but surely was accelerated, and it was decided, on December 3, 1957, in this apparently almost hopeless situation, to resort to very limited and localized curettage of the affected corneal area. However, this resulted in a perforation of the cornea and a collapse of the anterior chamber. A central 6-0 black silk suture was inserted in an effort to close the aperture. The suture extended from 5- to 11-o'clock and just crossed the borders of the perforation.

A lamellar keratoplasty was decided upon as the operation of choice. The eye being soft presented a difficult problem in outlining the six-mm. lamellar graft. However, this was done as best I could with



Fig. 2 (Grayson). Result of lamellar keratoplasty. The posterior opacity is in the deep layers of the cornea. This is becoming less dense.

fluorescein, and a lamellar resection approximating three quarters of the thickness of the cornea was dissected. The graft bed was irrigated with normal saline in hope of releasing some of the central necrotic coagulum. The deepest layers of the cornea showed some of the infiltration still present. The donor graft was applied to the recipient site and was sutured with eight interrupted 6-0 black silk appositional sutures. An attempt to instil air into the anterior chamber failed due to the softness of the globe.

Sulmyd ophthalmic drops and one-percent atropine were instilled in the eye. A bilateral patch was applied and the patient returned to the ward in good condition. Very little hope was held out for this eye since it went through such an extreme inflammatory reaction and insult before keratoplasty. The observational delay in performing the keratoplasty may have contributed to this reaction.

Postoperatively the chamber began to reform in two days, and on the 12th postoperative day the sutures were removed. The patient experienced steady improvement with corresponding diminution of the reaction in the eye and increase in the visual acuity. During the postoperative period 1.5-percent

hydrocortisone ophthalmic, one-percent atropine, and 0.5-percent acromycin drops were used with each dressing. The graft remained clear all through this period. The patient was discharged on December 23, 1957, to the out-patient department clinic where he was seen at increasingly longer intervals.

On April 22, 1958, the vision in this eye was 20/70 without correction. Some vascularization was noted in the recipient cornea. The influx of blood vessels stopped at the adjoining line between the donor and recipient cornea. The deep opacity that was seen in the remaining layers of the cornea is still present (fig. 2) and the donor cornea surrounding the original area of the perforation is completely clear.

It is encouraging to observe that the deep opacity is becoming less dense. On August 8, 1958, the patient was again seen in the out-patient department and a fairly marked decrease in the vascularization of the lamellar bed was noted; however, the visual acuity remained the same.

The main desire at the time was to save the eye by closing the dehiscence in the center of the cornea; in other words, I wanted to plug the dike and then at some future date do a perforating keratoplasty. In view of the better-than-hoped-for result as described in this report it seems unlikely that it will be done.

CONCLUSION

A case is presented wherein a secondarily infected central corneal perforation in a child was treated with a lamellar keratoplasty. It is suggested that lamellar keratoplasty be employed instead of the penetrating type in cases in which the penetrating procedure is considered too hazardous.

1100 West Michigan Street (7).

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SUTURE MARKER FOR KERATOPLASTY*

RAMÓN CASTROVIEJO, M.D.
New York

In circular keratoplasty the exact placement of sutures is essential in order to insure perfect coaptation of the edges of the graft with the incision in the recipient eye. I have devised an instrument for marking exactly corresponding points in the graft and in the host cornea so that the first three sutures can be correctly placed.

The new marker† (fig. 1) is composed of three points (B) which can be opened or closed by rotating a screw (A). Simple pressure of the points against the cornea leaves marks which can be made more easily visible by a staining solution such as fluorescein, methylene blue, or gentian violet. Grooves extending along the arms to the points (fig. 2-B) can be loaded with the stain so that it is deposited as the points touch the cornea, leaving clearly marked pin-point stains. One of the arms has been notched for identification so that it can be placed in a corresponding position in the donor and recipient eye.

The instrument is used as follows:

The area to be excised from the recipient eye is first marked with the trephine but without penetrating the cornea. Second, the marker is opened so that the points will make three marks one millimeter outside the outlined circle (fig. 3). The points are then adjusted to mark one mm. inside the trephine mark on the donor eye, also before perforating the cornea. The notched arm is placed in the same position in the donor and

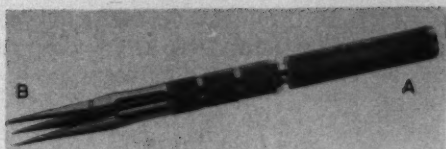


Fig. 1 (Castroviejo). Suture marker for keratoplasty.

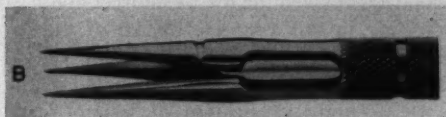


Fig. 2 (Castroviejo). Detail of the points of the marker.

host cornea, for example, at the 12-o'clock position. Temporary 6-0 silk tract sutures may be placed in both the graft and host eye to improve visibility of the points. This method is especially useful if the epithelium of the cornea is macerated so that the stained mark is not clear. Whether the keratoplasty is to be lamellar or full thickness, the cutting of the graft and the dissection of the host window are then completed, and the graft sutured in position with the permanent stitches placed through corresponding marks on the graft and recipient cornea. Additional stitches are then placed to complete the border-to-border suture of the graft into the bed.

9 East 91st Street (28).

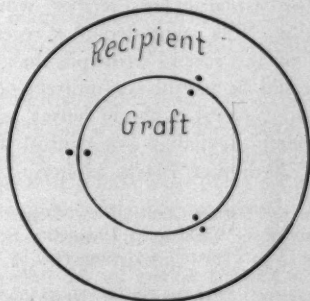


Fig. 3 (Castroviejo). Illustrating the position of the marks in the eye of the recipient and in the graft.

* From the Department of Ophthalmology of St. Vincent's Hospital, New York, The New York Eye and Ear Infirmary, and The New York University Post-Graduate Medical School. Presented before the Section on Ophthalmology of the New York Academy of Medicine, December 16, 1957, and before the American Ophthalmological Society, White Sulphur Springs, West Virginia, May 29, 1958.

† This instrument is manufactured by Storz Instrument Company, 4570 Audubon Avenue, Saint Louis 10, Missouri.

THE USE OF AN ASPHERIC LENS FOR INDIRECT OPHTHALMOSCOPY*

ROBERT E. CHRISTENSEN, M.D.
Saint Louis, Missouri

The development of the American Optical-Schepens binocular indirect ophthalmoscope has revived the use of indirect ophthalmoscopy in this country.¹ Much of the increased success rate of present-day retinal detachment surgery can be attributed to the more accurate localization of lesions made possible by this instrument.

Unfortunately, the lenses supplied with the American Optical-Schepens scope have some shortcomings. For example, although the 14-diopter lens is useful for the observation of minute fundus details, it is not comfortable for routine use. This is because of its long focal length which necessitates holding the lens at an awkward distance from the eye. The 20-diopter lens supplied for routine use has a quite limited clear field. Furthermore, both the earlier planoconvex and the more recent biconvex models of this lens have bothersome peripheral distortion due to spherical aberration. None of the mentioned disadvantages detract from the usefulness of the ophthalmoscope, but they make mastery of technique more difficult than it need be.

A desire to find a better lens for indirect ophthalmoscopy prompted this study. The use of an aspheric lens seemed worth investigating. Volk suggested in a recent discussion of the conoid principle that conoid lenses could be useful for indirect ophthalmoscopy.² Several aspheric lenses are now commercially available. For clinical trial we chose a 20-diopter Plasta aspheric cataract

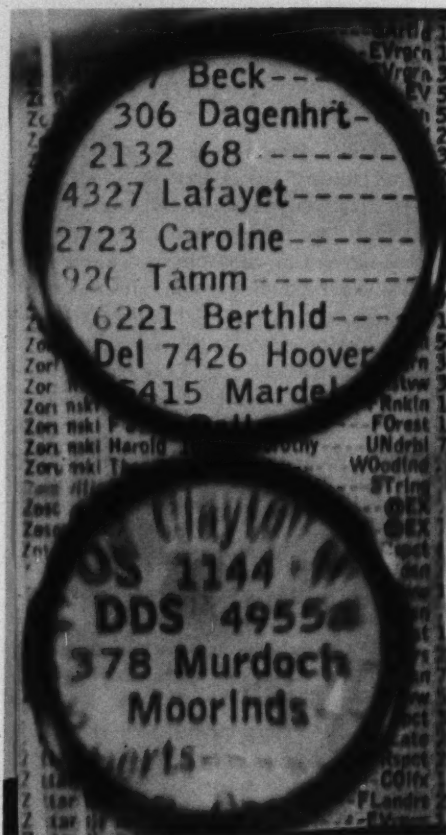


Fig. 1 (Christensen). The larger lens (above) is an aspheric S227R lens. The smaller lens (below), a spheric Schepens lens.

reader usually prescribed for low-vision patients.[†] This was modified by cutting off the quadriped-ring base, which left a large diameter (50 mm.) round lens in a 14-mm. wide plastic ring. The lens was light and easily held, and had excellent optical qualities. In comparison to the standard American Optical lens there was minimal peripheral distortion even though the lens diameter was 10 mm. greater. This yielded a much

* From the Retina Clinic of the Department of Ophthalmology, Washington University School of Medicine. This research was supported by a grant from The National Society for the Prevention of Blindness, Inc., 1790 Broadway, New York.

Grateful acknowledgment is made to Francisco Rodriguez Vasquez, M.D., and Mr. J. Louis Stevenson for their help in this study.

† Made by Combined Optical Industries Limited, Plasta Works, Bath Road, Slough, and available through the McLeod Optical Company, Inc., Providence, Rhode Island.

larger, clearer field, which afforded better and more rapid orientation. Also, the magnification was greater with the plastic lens (because of a difference in the lens base curves).

A 20-diopter Volk concoid lens of 40-mm. diameter was tried clinically and was also excellent. It had the one advantage of being glass rather than the more easily scratched plastic. However, we favored the Plasta lens because of its larger diameter and consequent larger field, lighter weight, greater magnification, and much lower cost.

The problem of view distortion in the peripheral retina is not solved and is partially a consequence of the physiologic peripheral flattening of the cornea. This astigmatic effect induced during oblique gaze can-

not be overcome by any lens (other than a corneal contact lens perhaps), but is decreased when an aspheric rather than the usual spherical lens is used. This is particularly evident in the area of the ora serrata.

SUMMARY

The use of an aspheric plastic 20-diopter lens in indirect ophthalmoscopy offers significant advantages over those presently supplied with the Schepens scope.

640 South Kingshighway (10).

ADDENDUM

Since acceptance of this article for publication, the Plasta lens has been modified and improved. Model S277R, 40 mm. in diameter and mounted in a black plastic ring holder, is now available from McLeod Optical Company, Providence, Rhode Island.

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A METHOD OF INDIRECT OPHTHALMOSCOPY*

JOSEPH AMDUR, M.D.
Philadelphia, Pennsylvania

There has been much recent discussion detailing the advantages of the Schepens binocular indirect ophthalmoscope.¹ Among the advantages listed are: (1) Greater penetration through hazy media; (2) larger field of view at the expense of magnification, thereby permitting ready understanding of over-all relationships in fundus pathology and a view of the ora serrata;² (3) brilliance of illumination enabling one to see details of small luminescent retinal tears; (4) depth perception due to the binocular vision of the instrument.

Among the binocular ophthalmoscope's disadvantages are: (1) Time is required to achieve proficiency in its use; (2) its size makes it cumbersome to carry and compli-

cated for ready usage, since it requires a wall source of current; (3) it is moderately expensive for the resident or beginning practitioner; (4) the image is inverted; (5) the bright light, causing photophobia, is distressing to the average patient.

Most of us readily admit the superiority of the Schepens ophthalmoscope over older methods of indirect ophthalmoscopy and we are anxious to popularize its usage. However, because of the disadvantages already listed, many practitioners have omitted indirect ophthalmoscopy from their armamentarium.

This omission can readily be remedied by a combination of the old method of indirect ophthalmoscopy with the new direct ophthalmoscope with which most of us are familiar. The combined method suggested by this paper has been known for years, as suggested by Bell, Berens, and Langdon;³⁻⁵ However, many of us neglect its use.

In this procedure, the examiner uses the light source from the ordinary direct oph-

* From the Wills Eye Hospital.

thalmoscope, either battery or electric, held about one meter from the patient. He places the desired plus sphere (anywhere from plus 10 to plus 25 diopters) about six cm. from the patient's eye. This produces a real, lowly magnified but inverted image of the fundus between the convex lens and the examiner and allows for an easily seen wide scanning view of the fundus, very similar to that seen with the Schepens binocular indirect ophthalmoscope. The examiner may aid his accommodation by placing a plus 1.0 to plus 3.0D. sph. before his eye in the direct ophthalmoscope head.

This combined method is quick, convenient, and inexpensive. Very little time is required to gain proficiency in its use and the light is not strong enough to cause photophobia in the average patient. However, the bright light source and binocular image of the Schepens scope still have admitted superiority.

The method described should enable every practitioner to include indirect ophthalmoscopic examination of the fundus as part of his routine examination.

1601 Spring Garden Street (30).

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A "TUBO-STAT"*

TO FACILITATE HANDLING OF TUBING IN
SCLERAL BUCKLING PROCEDURES

EARL L. LEWIS, M.D.
Hempstead, New York

As the scleral buckling operation is being performed with greater frequency in most of the major ophthalmologic centers, new instruments are being devised and old ones modified to facilitate this somewhat involved and lengthy procedure. At present the passing of the polyethylene tubing beneath the sutures is clumsy and awkward and may result in damage to the tube or unnecessary trauma to the eye.

An astonishingly simple instrument for handling tubes of any size is easily made by drilling a hole in the end of a mosquito hemostat (fig. 1). The drill sizes which correlate with the most frequently used tube sizes are shown in Table 1.

The tubing may be firmly gripped with-

out injuring it and passed under each of the mattress sutures. Using two of the "tubo-stats" juxtaposition of the ends of the en-

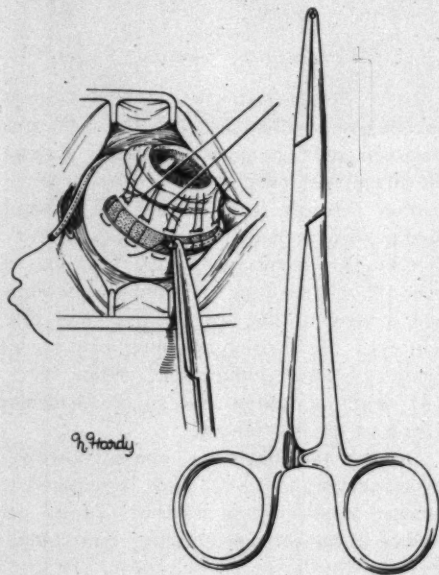


Fig. 1 (Lewis). A "tubo-stat."

*From the Manhattan Eye, Ear, and Throat Hospital.

TABLE 1
INTRAMEDIC TUBING
(Clay Adams)

Number	Inside Diameter (inches)	Outside Diameter (inches)
205	0.062	0.082
200	0.055	0.075 ¹
190	0.047	0.067
90	0.034	0.050 ²
50	0.023	0.038

¹ Usually used for sleeve.

² Usually used for encircling tube.

circling tube is achieved, relieving all tension on the 2-0 silk suture so that tying is greatly facilitated. Adjustment of the tubing to its final position is simpler with this instrument, and the protective sleeve can be moved into place with relative ease.

I have also prepared one of these "tubostats" for holding and passing the very fine plastic tubing used in repair of the lacrimal canaliculi and find it quite useful.

131 Fulton Avenue.

A SCANNING PUPILLOMETER*

LILLIAN S. KUMNICK, PH.D.

New York

INTRODUCTION

The pupillometer is an instrument for measuring the response of the pupil of the eye, the amount of contraction or dilation, and the dynamics of these responses relative to a host of physiologic, psychologic, and pharmacologic stimuli. The need for a completely automatic system for measuring, computing, and storing the myriad of data gathered during the course of research has led to the development of the electronic scanning pupillometer. By producing, instantaneously, a continuous graphic record of pupil diameter, it eliminates the laborious,

* From the Lenox Hill Hospital. This investigation was supported by a research grant, B-991, from the National Institute of Neurological Diseases and Blindness, National Institutes of Health, Public Health Service.

time-consuming work of frame-by-frame measurement and plotting required by previous methods employing motion picture techniques. Often, the graphic response curve is not needed, and the data are directly reduced to parameters of interest, the graphic record serving mainly as a visual guide to the selection of the desired epochs. Here, the advantages of automatic data reduction are invaluable. The development of an accurate, versatile scanning pupillometer has been the first step toward the production of the completely automatic instrument.

A working model of the pupillometer has been built and installed in the Ophthalmological Department at Lenox Hill Hospital, New York.[†] Utilizing an infrared scanning system, the pupillometer measures instantaneous changes in pupil diameter and records them as a continuous graph on a chart recorder.

PERFORMANCE

The present instrument has shown itself capable of producing faithful recordings of pupil responses. Briefly, the instrument is capable of: (1) measuring pupil diameter in the range 0.5 to 10 mm. with an accuracy of ± 0.1 mm.; (2) providing a continuous chart record of the dynamic response over a range of zero to two cycles per second (limit imposed by recorder), otherwise, zero to eight cps at a linear chart speed of one inch per second; and (3) storing the data in analog form on 0.25-inch magnetic tape.

In addition, a number of desirable features have been incorporated in the present design. These include: (1) continuously variable control of the intensity of the stimulus light from a maximum of nine foot-candles; (2) automatic control of the stim-

[†] The apparatus was especially constructed and engineered by the Airborne Instruments Laboratory, Inc., Mineola, New York, under the direction of Walter E. Tolles, chief, Department of Medical and Biological Physics, for Lillian S. Kumnick, Ph.D., as the principal investigator in pupillographic studies.



Fig. 1 (Kumnick). Scanning pupillometer.

ulus epoch cycle, with "on" and "off" times continuously adjustable from 0.1 to 10 seconds "on," and 0.2 to 20 seconds "off"; (3) precision focusing and positioning of the optical system to within 0.001 inch; (4) a unique system for insuring stability of the head position without the use of head clamps or bite bars, thus affording the subject a high degree of comfort; and (5) visual monitoring of the electrical signal to insure absolute adjustment and alignment of the scanning system.

PRELIMINARY TESTS

Preliminary tests indicated that the ability of the pupillometer to produce faithful records of pupil diameter is related to the difference between the pupil and iris absorp-

tion levels detected by the infrared scanner. Consequently, tests were performed on 30 subjects, 19 with blue eyes, to determine the range of iris-to-pupil absorption ratios that might be encountered in practice. The results of these tests are shown in Table 1. Most blue-eyed subjects had absorption ratios in the range 80 to 85 percent, while a few showed absorption ratios as high as 90 to 95 percent. Most brown-eyed subjects had ratios below 80 percent.

SPECIAL ADDITIONAL FEATURES

In order to accommodate a wide range of absorption ratios, a special discriminator system was devised. The present instrument contains an adjustable control which when properly set will enable precise recordings to be made even when the iris-pupil absorption ratio is as high as 95 percent. Since proper adjustment of the control is critical, a special oscillographic monitoring system was built which enables the operator to determine visually when the point of optimum adjustment has been achieved.

The present machine uses a silent electronic timer for control of the stimulus epoch. The electronic timer replaces the original electromechanical unit which generated excessive audible noise. This noise proved to be a source of unwanted psychologic stimulation.

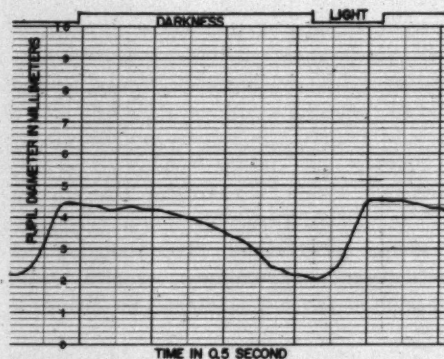


Fig. 2 (Kumnick). A continuous graphic record (reading from right to left) of pupil diameter obtained by means of the scanning pupillometer described in this paper.

TABLE 1
RESULTS OF IRIS-TO-PUPIL ABSORPTION
RATIO TESTS

Iris/Pupil Absorption Ratio	% of Brown- Eyed Subjects	% of Blue- Eyed Subjects
0.51 to 0.55	9.1	—
0.56 to 0.60	—	—
0.61 to 0.65	9.1	—
0.66 to 0.70	27.3	—
0.71 to 0.75	9.1	5.3
0.76 to 0.80	27.3	10.5
0.81 to 0.85	18.1	68.4
0.86 to 0.90	—	10.5
0.91 to 0.95	—	5.3
	100%	100%

CURRENT STUDIES

Specific preliminary experiments now in progress which will yield valuable results for planning future experimental designs are:

1. *Effects of intensity of stimulation on the dynamics of the pupillary response.* Though the degree of contraction of a pupil as a function of stimulation level has been displayed, the response time, the rates of contraction, and subsequent dilation have not been explored. By varying the stimulus level over a wide range, it is expected that some interesting relationships between the strength of response and the rates of response and decay will appear.

2. *Effects of the stimulus cycle program on the dynamics of the pupillary response.* Most workers in pupillometry have adopted a fairly standard regimen of stimulus duration and stimulus repetition rate. Both of these parameters are being varied and the changes, if any, of the rates of contraction and dilation will be examined.

3. *A quantitative study of hippus.* The amplitude and frequency characteristics of hippus are being explored as a function of intensity of illumination. This preliminary study is simple to make, and its results may be rewarding, perhaps to the point of using

the frequency-amplitude characteristics of hippus as a revelation of some of the neuromuscular responses to systemic or pharmacologic influences.

Two clinical studies on pupillography in demyelinating diseases and in macular diseases are now being made. Data on normal people of various age groups which will serve as controls are also being collected.

FUTURE PLANS

The next step in this project is the completion of the design and construction of the automatic data processing equipment which is an important and necessary adjunct to this method in order to eliminate the present time-consuming and laborious measurement and plotting of data.

The apparatus planned represents such a fundamental departure from the present methods of pupillography that it should make it a practical source of important information, not now available, for many medical specialties and disciplines and for experimental studies, as well as for the studies planned for this project. New lines of investigation may be opened and new hypotheses developed which may be tested.

601 West 115th Street (25).

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

MADRID OPHTHALMOLOGICAL SOCIETY

May 28, 1958

DR. ARJONA, *presiding*

OPERATIONS FOR RETINAL DETACHMENT

DR. MARIN AMAT referred to seven very complicated cases of retinal detachment which he had presented before the French Ophthalmological Society in 1955. These cases had been favorably treated with surface diathermy and evacuation of subretinal fluid. Neither total nor partial scleral resection, as recommended by Lindner and Paufigue and Hugonnier, had been used. Dr. Amat considered three factors of primary importance in the surgery of detachment:

1. Total evacuation of subretinal fluid.
2. Shrinkage of the ocular walls to dislodge the choroid toward the retina.
3. Production of an inflammatory reaction in the choroid so that it would adhere to the retina.

The second factor may be attained by the use of polivil tubing according to Custodius; a tube of polyethylene according to Schepens; pieces of resected sclera, according to Chamblin and Rubner. These techniques are, however, time consuming and occasionally complicated by rupture of the choroid, intraocular hemorrhages, staphyloma, foreign-body reaction, and diplopia due to muscle adhesions. Instead of these techniques, diathermy should be used more frequently.

Discussion. DR. BARTOLOZZI emphasized the importance of diathermy and favored the use of air and vitreous to force the choroid back into place. He is against the use of foreign-body material for he believes the eye cannot tolerate it. He has used a modified Arruga technique, suturing through the

sclera a fewer number of times. He believes diathermy over more than three quadrants is a dangerous procedure.

DR. ARJONA agreed with Dr. Amat but prefers to use scleral resection with diathermy in very bad cases.

In reply DR. AMAT said that he prefers the use of diathermy and pointed out that the Lindner scleral resection has been replaced by the Paufigue and Hugonnier technique. He disproves the use of foreign-body implants, having observed the deleterious effects of the Ridley lens and of nasolacrimal tubes. In his opinion, Strampelli's lenses have yet to be judged. Michiels has reported on tendencies to extrude such implants, as well as acrylic, in detachment cases and there have been reports of intolerance to such materials.

In Dr. Amat's opinion, air injection into the vitreous is not sufficient to push the choroid against the retina because air reabsorbs rapidly and it is not always possible to determine whether the air has leaked through the tear. Arruga's operation of constricting the globe by encircling it with sutures does not accomplish its purpose for the globe will recover its normal form. Dr. Amat feels that the good results obtained by Arruga's method have been due to the release of subretinal fluid and the use of diathermy rather than to the shortening produced by sutures.

Olga Ferrer,
Translator.

MEMPHIS EYE EAR, NOSE AND THROAT SOCIETY

MACULAR EXUDATES

DR. MARGARET A. HALLE presented C. A., a 28-year-old white man first seen for a routine refraction on October 31, 1957, with the chief complaint of his vision getting dim.

He had noticed a blur in front of his left eye September 15, 1957, after driving. His vision was R.E., 20/15; L.E., 20/20. After cycloplegic refraction he was found to have compound hyperopic astigmatism: R.E., +1.75D. sph. \ominus +0.5D. cyl. ax. $100^\circ = 20/15$; L.E., +2.5D. sph. \ominus +0.5D. cyl. ax. $60^\circ = 20/15$. Fundi were normal.

He presented himself again November 19, 1957, complaining of a blur in the left eye. At this time there were several small hard exudates in the macular region, right eye, and the left eye showed swelling (retinal edema) in the macular area. Fields were normal. All laboratory tests, X-ray studies, dental and physical examinations were normal. On November 26th, he was started on Meti-corten, and continued on this for four weeks, gradually cutting the dose the last two weeks. His fundus was completely clear December 21, 1957. On December 31, 1957, he had some retinal edema centrally in the right eye, he had three small hard exudates in the left macular area. He was again started on Meti-corten and Chloromycetin. January 7, 1958, there was one new exudate in the right eye, the left eye showed beginning pigmentation of the exudates. At his most recent visit, vision was R.E., 20/15; L.E., 20/25-1.

Fundus examination shows one exudate in right eye but retinal edema still persists. The left eye shows new exudate near the inferior temporal vein. The central area shows healed choroiditis.

PERIPHERAL RETINAL HEMORRHAGE

DR. ALICE R. DEUTSCH presented a 15-year-old Negress, first seen in John Gaston clinic in October, 1953, at the age of 10 years. At this time her vision was 5/200 in each eye with J8 near vision. There were bilateral vitreous hemorrhages which appeared to be organizing. There was no history of past visual disturbance.

She had been premature at birth in John Gaston Hospital, with the birth weight of four pounds three ounces. She received no

oxygen and had a negative Kahn at the time. She had whooping cough and measles in childhood. The family history was noncontributory.

The girl was admitted to the hospital. There was slight anemia (RBC: 3.5 million; Hgb, 12 gm. percent). Complete work-up for granulomatous diseases showed only the following positive findings: PPD #2-1+; typhoid agglutination positive 1-80, bleeding and clotting time and thrombocytes were normal.

Within two weeks vision had improved to 20/50 and J2. Large vitreous floaters were present, particularly in the temporal portion of each eye. The right eye had much scar tissue and a large band extending superiorly from the disc. The left eye had a hemorrhage below the macula.

The patient failed to keep her appointment and was not seen again until three years later in July, 1956, when she was referred by a school nurse because of poor vision. The vision at this time was: O.D., counting fingers at two feet; O.S., 20/30+2 and J1 with a -6.0D. sph. \ominus +2.0D. cyl. ax. 85° .

In April, 1957, the right eye suddenly became intermittently painful as if there were pressure from behind. There was moderate ciliary flush, posterior synechias, aqueous flare, and absence of any retinal reflex. The left eye showed pathologic alterations only in the retinal periphery where there were many small retinal and preretinal hemorrhages with connective-tissue formation below and in front of the retina. The vitreous was relatively clear.

The patient was readmitted to the hospital. A complete work-up again was not significant. Several preparations for sickle-cell were negative. The process continues to be active in varying degrees on each visit. The patient was readmitted to the hospital on January 8, 1958, for further study. At present the visual acuity is no light perception in the right eye and 20/25-3, J1 in the left with correction.

The right eye has a ring-shaped posterior synechia with a pupillary membrane. There is apparent iris bombé but the eye is soft. There are several central faint corneal opacities, very superficial in the epithelium, encroaching on Bowman's area. The vitreous is relatively clear. Just below the lower foveal margin is a peculiar strand-shaped formation below the depth of the retinal vessels. The disc is normal.

In the fundus periphery there is sheathing of some of the arteries and veins, extending back behind the equator. There are areas of fresh small retinal and preretinal hemorrhages adjoining old areas of hemorrhage and organization with fibrous and new-vessel formation extending into the vitreous. These areas of hemorrhages are all around the periphery from in front of the equator to as far as can be visualized. In the infero-temporal quadrant there is one exceptionally large area of fibrous tissue with new-formed vessels and fibrous tissue extending several diopters into the vitreous.

The prognosis seems grave and it is hoped that a proper diagnosis and treatment can be established. Hannon, in the November, 1946, *AMERICAN JOURNAL* describes three cases with somewhat similar lesions in the retinal periphery due to sickle-cell disease which were treated with surface diathermy. In one case the results were excellent. The other two had not then been observed for a sufficient time.

VISUAL RESULT AFTER GONIOTOMY

DR. J. WESLEY MCKINNEY reported the case of W. McB., aged five months, who was first seen on June 12, 1945, at the Eye Clinic of the Memphis, Eye, Ear, Nose and Throat Hospital.

He had had a bilateral trephination for congenital glaucoma six weeks previously. The tension, however, was again elevated, and both corneas showed edema and generalized cloudiness. Both trephination blebs were flat and evidently not filtering.

Under ether anesthesia, the tension was

found to be 30 mm. Hg (Schiotz) in each eye. The corneas measured 13 mm. in diameter. Goniotomy was performed, opening about one fourth of the angle in each eye. The postoperative course was uneventful.

The child was seen again six months later. The corneas were clear and the tension was so definitely normal to fingers that he was not checked under anesthesia.

He returned for check-up on December 22, 1954, now aged nine years. Unfortunately, I did not see the child myself at this time, but the clinic note showed the vision to be: O.D. 20/20; O.S., 20/40. Tension was found to be: O.D., 19 mm. Hg and O.S., 15 mm. Hg (Schiotz). It was reported to me that the eyes seemed a little large but otherwise they appeared in every way normal.

He again returned to the clinic November 28, 1956, now aged 11 years. His clinic note showed refraction to be: O.D., +0.25D. sph. \ominus +0.25D. cyl. ax. $80^\circ = 6/6$; O.S., +0.5D. sph. \ominus +0.5D. cyl. ax. $65^\circ = 6/7.5-2$.

The corneas were clear and measured 13 mm. in diameter in each eye. The tension was: O.D., 19 mm. Hg; O.S., 20 mm. Hg (Schiotz). The fundi were normal.

Eugene A. Vaccaro,
Secretary, Eye Section.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

December 11, 1958

DR. HAROLD G. SCHEIE, *Chairman*

SUPERIOR OBLIQUE TENDON SHEATH SYNDROME OF BROWN

DR. FRANCIS HEED ADLER: The syndrome described by Dr. Harold Brown in 1950, known as the superior oblique tendon sheath syndrome, consists in an apparent inferior

oblique paralysis on a congenital basis. It can only be distinguished from a true inferior oblique paralysis by applying the forced duction test. The globe cannot be passively rotated above the midline in the field of action of the inferior oblique muscle. Various operative procedures have been tried without much success. The result of these has generally been freeing the globe so that it could be passively rotated upward, but in most cases the patient cannot voluntarily move the eyes in this direction any better than before operation.

Costenbader and Albert (*Arch. Ophthalm.*, 59:607, 1958) report a case with spontaneous cure. I am putting on record a similar case. The child, P. B., four years of age, was first seen September 8, 1955, with a typical picture of a left inferior oblique paralysis. I advised doing a forced duction test under anesthesia and deciding at that time what operative procedure to carry out, depending upon whether or not this was found to be a true Brown syndrome. This advice was not accepted and the parents decided to do nothing about the condition. The child was seen again on May 26, 1958. No treatment had been given in the meantime. The eyes were straight in all positions of gaze, there being no sign of any left inferior oblique paralysis remaining.

While it cannot be stated with certainty that this was a true superior oblique tendon sheath syndrome, it indicates that spontaneous recovery is possible either in cases of this syndrome or inferior oblique paralysis. Immediate operation is therefore not indicated and, in view of the uncertain operative results, should probably be deferred until these children are older.

ANTIBODY PRODUCTION IN RABBIT'S EYE

DR. MICHAEL J. WOLKOWICZ, DR. JOSEPH W. HALLETT, AND DR. IRVING H. LEOPOLD: The study of antibody formation by the uvea in vitro is an outgrowth of our interest in uveitis. Those data can influence our

thinking in regard to the etiology of uveitis and our therapeutic approach. This work is based on previous studies made by Witmer on experimental uveitis, on our studies on Cx-reactive protein, on the work of A. Fagraeus and others on antibody formation and on the studies by Coons and his associates on antigen tracing by means of the fluorescein conjugation technique.

The laboratory method consisted in injecting a chosen antigen (standard typhoid-paratyphoid vaccine) intraocularly by different routes and keeping the uveal fragments in culture media. The antibody titers of the successive culture tubes represent the antibody activity of the given fragment. The uveal tissue production of antibodies could be further potentiated by increasing the antigenic concentration.

Typhoid "H" proved to be a more stimulating antigen by forcing the uveal fragments to produce antibody titers above the blood serum level. Uveal tissue, where living cells were destroyed by immersion in formalin, showed a reserve of antibody deposits. The origin of those agglutinins is still uncertain. Further concentration of typhoid "H" suspension produced higher peaks of antibody titers but also earlier exhaustion.

LENS SYSTEM FOR WATER-TO-AIR VISION IN SUBMERGED EYE

T. D. DUANE (by invitation): A Navy project required the circumvention by the submerged human eye of the water-to-air total internal reflection when placed 7.8 cm. from the interface separating the media.

A lens system was developed and the reasoning leading to the evolution of the final product, a 16-diopter planoconvex lens with a superimposed 52.5-diopter loupe, was presented. With this combination of lenses, subjects were able to see through the interface with 6/6 acuity, a field of vision of 20 degrees, and a full range of accommodation.

William E. Krewson, 3rd,
Clerk.

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THE SPRING MEETINGS 1959

The 95th meeting of the American Ophthalmological Society was held May 28th, 29th, and 30th at the comfortable Homestead of Hot Springs amid intermittent Virginia spring sunshine and showers. Derrick Vail presided at each of the meetings. With this office, Dr. Vail has been president of the American Ophthalmological Society and American Academy of Ophthalmology and Otolaryngology, Chairman of the Section on Ophthalmology of the American Medical

Association, and Chairman of the Board of Trustees of the Association for Research in Ophthalmology. Attending the sessions were 132 members and 34 guests.

The papers which led to much discussion dealt, for the most part, with purely clinical topics. Ludwig von Sallmann and David Paton described a new, apparently genetic, condition in which there were sharply defined vascularized plaques in the limbus occurring in an isolated North Carolina family clan of Indian, white, and Negro origin. C. Wilbur Rucker, William P. Keefe,

and James W. Kernohan presented an exquisitely illustrated discussion of the pathogenesis of paralysis of the third cranial nerve. Particularly important was the variation in position of the carotid vasculature and its branches about the third nerve at the base of the brain.

Benjamin Sheppard systemically studied the intrascleral drainage channels of the normal rabbit eye and his findings brought forth a surprising amount of discussion suggesting that the rabbit was an unusually poor experimental animal for intraocular pressure investigation. Angus L. MacLean and A. Edward Maumenee discussed hemangioma of the choroid with particular emphasis upon differentiation between choroidal angioma and malignant melanoma. Of particular interest was the observation that the intravenous injection of fluorescein caused a bright yellow-green fluorescence in hemangiomas.

John (Rochester) Henderson's discussion of expulsive choroidal hemorrhage associated with cataract extraction precipitated the discussion of a series of case reports, largely hair-raising, in which this complication has occurred. A surprising number of eyes with useful vision were retained. F. Phinizy Calhoun and William S. Hagler described the Barraquer method of extracting the dislocated lens in which a double-pointed needle is passed through the pars plana.

Paul A. Chandler spoke on the diagnosis of glaucoma occurring with a completely dissociated hypermature cataract and this brought forth much discussion. Parker Heath reported the first instance of ocular involvement in acute disseminated histiocytosis of Letterer-Siwe. The changes were largely isolated in the sclera and the retina.

A number of other excellent papers were read and there was a greater tendency than in years past toward topics involving research.

Dr. M. Elliott Randolph, chairman of the Committee on Prizes, in a delightful presentation made the award of the Howe Medal, the American Ophthalmological Society's

highest honor, to Ludwig von Sallmann for his continuous and outstanding work in both clinical and investigative ophthalmology during the past 40 years. Dr. von Sallmann was obviously greatly surprised and moved by this recognition. Sir Stewart Duke-Elder, one of the three honorary members of the society, gave an illustrated talk on "The Hospitalers of the Order of St. John at Jerusalem" with his usual urbanity and skill.

At the annual executive session, it was announced that Gordon M. Bruce, who has edited the *Transactions* of the society with unusual sagacity and competence the past 10 years, would be succeeded by M. Elliott Randolph. The editing of the *Transactions*, which contain each of the papers read at the meeting, plus the theses required for membership, is a monumental editorial task and the appreciation of the members for the time and the proficiency that Dr. Bruce devoted to this work was indicated, albeit inadequately, by a rising vote of thanks. Algeron B. Reese, the present vice president, was elected president to succeed Derrick Vail. Edwin B. Dunphy of Boston was elected vice president. Maynard C. Wheeler, whose name has become synonymous with the American Ophthalmological Society and its efficient operation, was re-elected secretary-treasurer. The next meeting will be held May 16, 17, and 18, 1960, at the Broadmoor, Colorado Springs, Colorado.

The 108th annual scientific assembly of the American Medical Association took place June 8th to 12th, at Atlantic City. As always, the meeting was a hectic miscellany of scientific papers, exhibits, television, movies, alumni reunions and visits with friends from the Service, prematurely aging college classmates, fellow interns and residents. As seems to be always true at this meeting, there were just not enough hours in the day to do everything one wished. Drug houses, instrument makers and publishers had their usual attractive displays, and there was no shortage of enticingly distributed soft drinks, decaffeinated coffee, sugarless confections and the like. The scientific exhibits reflected the re-

markable increase in medical research in all fields. As usual the teaching and research exhibits permitted the ophthalmologists to become familiar in a most rapid and painless manner with the techniques and advances in related fields.

There were 14 exhibits from the Section on Ophthalmology. These varied so much in subject matter and manner of presentation, that it is nearly impossible to state which was the most interesting. However, the sections' exhibits were among the best ever presented. The most important role of these exhibits would appear to be in permitting fellow physicians to learn the problems of clinical ophthalmology and the trends in ophthalmic research. There is no other national meeting at which this can be accomplished.

The exhibit of Gilbert Baum and Ivan Greenwood of the Veterans Administration Hospital, Bronx, New York, "Application of ultrasonic locating techniques to ophthalmology," was awarded the Certificate of Merit and, with it, the prize of \$250.00 of the Section on Ophthalmology for the best exhibit. Honorable mention was awarded to Mansour F. Armaly of the State University of Iowa, at Iowa City, for the exhibit, "Intraocular effects of parasympathetics in the cat: Morphology and fluid dynamics," and to Theodore Wanko of the National Institutes of Health, Bethesda, Maryland for the exhibit, "The crystalline lens: Electron microscopic investigation of the normal fine structure and of experimentally induced cataracts."

The section met at the Ambassador hotel during the last three days of the meeting under the chairmanship of Frank B. Walsh of Baltimore. The program, as always, covered a wide variety of clinical subjects. The final session consisted entirely of papers on the topic dearest to the chairman's heart, neuro-ophthalmology. The invited foreign guest was Prof. S. P. Meadows of Queen's Square, London, who spoke on midbrain lesions. The guest-of-honor was Paul C. Bucy of Chicago, who discussed tumors of

the brainstem with emphasis upon the ocular findings. The chairman spoke engagingly of the new medical school program at Johns Hopkins designed to accelerate the training of physicians.

The section awarded its prize of \$250.00 for the best presentation to Thomas P. Kearns, Robert M. Salassa, James W. Kernohan, and Collin S. MacCarty of Rochester, Minnesota, who discussed the ocular manifestations of pituitary tumor in Cushing's syndrome. In a series of 120 patients with Cushing's syndrome, 12 had a pituitary tumor which was more active in causing visual field defects and oculomotor nerve palsy than in those patients who did not have the co-existing syndrome.

At the annual business meeting the Medal-of-Honor of the section for distinguished service to ophthalmology was awarded to Francis Heed Adler of Philadelphia for his many contributions as an investigator, writer, editor, and teacher. Dr. Adler, in his acceptance, graciously compared himself to a Boswell responsible only for recording the sayings and doings of the many Johnsons in American ophthalmology.

Harold G. Scheie was elected chairman of the section. For the past six years Dr. Scheie has provided outstandingly able leadership as secretary of the section and has established a resourceful program committee so that the program this year was selected from over 60 papers. He was succeeded as secretary by Henry Freeman Allen of Boston. Phillip Meriwether Lewis of Memphis, vice chairman, was succeeded by Paul A. Chandler of Boston. Renamed to their posts were Ralph O. Rychener of Memphis and W. Harold Morrison of Omaha as delegate and alternate delegate from the section to the House of Delegates of the American Medical Association, and Frank W. Newell as representative to the Scientific Exhibit. The next annual meeting of the American Medical Association will be held in Miami Beach June 13 to 17, 1960.

The 28th meeting of the Association for

Research was held in conjunction with the section meeting under the chairmanship of Hunter H. Romaine of New York City. A wide variety of papers was presented, covering nearly every aspect of experimental ophthalmology, with information presented on microscopy, hypersensitivity, biochemistry of the cornea, lens, aqueous humor, electroretinography, pupillography, and neuro-ophthalmology.

Prof. Hans Goldmann of Berne, Switzerland, received the Proctor Medal of the Association for his continued and valuable contributions to research and clinical ophthalmology over a many-year span. He spoke on basic problems of glaucoma and emphasized the importance of the outflow mechanism.

The Friedenwald award was given to Werner K. Noell for his many contributions to basic ophthalmology, particularly his studies on the nature of the visual impulse. Each of the recipients spoke briefly at a pleasant annual banquet.

At the annual business meeting, Irving H. Leopold of Philadelphia was elected a trustee of the Association for Research. The energetic Lorand V. Johnson of Cleveland was re-elected to the post of secretary-treasurer by acclaim. The association, from the time it was founded, has been particularly fortunate in having dedicated and imaginative secretaries so that now, at its annual, sectional and interim meetings, more papers are presented than at any other ophthalmic society in the world. It was proposed that the interim meeting be held jointly with the Southeastern Section during the first week of December and the joint meeting has been scheduled for December 3rd, 4th, and 5th in Augusta, Georgia.

The week of the American Medical Association meeting is one of the busiest in ophthalmology. It is virtually impossible to hear all of the papers that one wishes and to study the exhibits one believes important. Like the little child at the circus, however, one completes the meeting with the feeling that although he has seen only a small por-

tion of the show, those acts he saw were wonderful.

Frank W. Newell.

INTERNATIONAL COUNCIL OF OPHTHALMOLOGY

The International Council met in Paris on May 9, 1959. The following were present:

Duke-Elder (president), Berens (vice president), Hartmann (secretary), Streiff (treasurer), Arruga, Espildora Luque, Lyle, MacDonald, Melanowski, Müller, Paufigue, Uyemura, Weve, Bietti (International Organization against Trachoma), Franceschetti (International Association for the Prevention of Blindness), François (European Society of Ophthalmology), Payne (Pan-American Association of Ophthalmology), Coppez (president of the last congress), Sen (president of the next congress).

The more important business concerned the following:

1. *Index Ophthalmologicus*. In view of the expense it was decided not to publish the new edition for the International Congress in 1962 but to defer this until 1966.

2. *The XIX International Congress in Delhi*. Dr. Keran Sen, proposed by the All-India Ophthalmological Society, was accepted as president-designate. The congress itself will be held in New Delhi from December 3 to 7, 1962. The full subscription for delegates will be 150 rupees (£10; 30 U.S. dollars); for associate members the subscription will be one third of this, and a 10 percent surcharge will be added to those who do not belong to a society affiliated with the International Federation. Members of council and secretaries of the various ophthalmological societies affiliated with the federation are asked to forward suggestions for the two major discussions and four symposia, to the secretary of the council, Dr. Edward Hartmann (2 Avenue Ingres, Paris, France), before May 1, 1960. The number of free papers will be limited to 50, which

will be chosen from those offered by a committee of the International Council. The same committee will consider the films offered in order to eliminate those which are out of date, such as have been shown at previous congresses.

3. *Three new ophthalmological societies* were admitted to the federation, those of the Section of Ophthalmology of the Society of Medical Sciences of Lisbon, and the Ophthalmological Societies of Hong-Kong and Hungary.

4. *Standardization of tonometers.* A commission was set up to consider the advisability of the standardization of the X-tonometer and the applanation tonometer. The following have been invited to serve: Goldmann (Berne), Jackson (Edinburgh), Kronfeld (Chicago), Mahneke (Copenhagen), and Müller (Bonn).

5. *Standardization of clinical records.* While the council considered that it was not possible to suggest the standardization of clinical records which would be accepted by all countries, a commission was appointed to study the possibility of some standardization in records for glaucomatous patients and for patients who are travelling from one country to another. The following have been asked to serve: Berens (New York), Bietti (Rome), Franceschetti (Geneva), and Müller (Bonn).

6. The next meeting of the council will be held at Athens on April 16, 1960, immediately prior to the opening of the first congress of the European Society of Ophthalmology.

Stewart Duke-Elder.

CORRESPONDENCE

CHLOROMA OF ORBIT

Editor,
American Journal of Ophthalmology:

In the January, 1959, issue of THE AMERICAN JOURNAL OF OPHTHALMOLOGY, Dr. S. P. Mathur of Rajasthan (India) has reported four cases of chloroma of the orbit.

The sternal blood picture of Cases 2 and 3

show that the blast cells are mostly lymphoblasts, while the peripheral blood picture of Case 2 presents 68 percent of lymphocytes and that of Case 3 only 35 percent, while the rest of the cells are mostly of myelogenous origin, or are unidentified immature cells. In short the findings of the myelogram do not correspond very well with that of peripheral blood. I have also come across cases of chloroma of the orbit in which atypical blast cells and the more mature cells of the myelogenous series were found in the blood. These atypical blast cells are easily confused with lymphoblasts or monoblasts but closer study reveals that they are actually myeloblasts with monocytoid shapes. Such a leukemic blood picture as described is referred to in the literature as that of paramyeloblastic leukemia (Naegeli type).

I have reported such a case in the January, 1959, issue of the *British Journal of Ophthalmology*. I think a closer study is required in Dr. Mathur's Cases 2 and 3. In my experience chloroma is never associated with a lymphoblastic blood picture.

(Signed)

Sami Hameed,

Department of Pathology, Institute of
Ophthalmology,

Muslim University, Aligarh, India.

* * *

REPLY

Editor,
American Journal of Ophthalmology:

It was a pleasure to receive the comments of Dr. Sami Hameed on my report of four cases of chloroma.

The blood and marrow pictures of Cases 2 and 3 were definitely of acute aleukemic leukemia. Nearly one third of all cases of acute leukemias manifest themselves in aleukemic form.

In Case 3 the peripheral blood contained as many as 63 percent of immature cells. A definite conclusion could not be arrived at as to their being of the granular or agranular series. Because of the variants in the con-

dition, an opinion was withheld until the marrow could also be examined; the cells then were finally identified as lymphoblasts.

While examining Case 2, naturally my first presumption was of the usual chloroma of the myeloid series. But the peripheral blood showed a very small percentage of cells of this series. The bone-marrow smear, examined thoroughly, further brought out the very interesting and rare finding that this case was also lymphoid in type.

It is well known that a few immature cells of one type may occur in leukemias of another type.

Though it is not possible to arrive at a definite conclusion from a series of only four cases, it does appear as if the predominance of the myeloid type of chloroma is rather overemphasized in the literature, particularly so when it is fairly well known that acute lymphoid leukemia occurs in much higher percentage in children and approximately equals the total of myeloid and monocytoid varieties. (Signed) S. P. Mathur,

P. B. M. Men's Hospital,
Bikaner (Rajasthan) India.

BOOK REVIEWS

ATLAS OF THE OCULAR FUNDUS. By Prof. Dr. Oswald Marchesani and Prof. Dr. Hans Sautter. (Translated by A. Philipp, J. Nordmann and R. Lienau.) New York, Hafner Publishing Company, Inc., 1959. 160 pages, 161 plates, with 262 colored and 13 black and white illustrations. Price: \$80.00.

On the occasion of the centennial of Helmholtz's invention of the ophthalmoscope, C. Wilbur Rucker and Thomas E. Keys of the Mayo Clinic showed an exhibit of atlases of ophthalmoscopy (1850-1950) at the annual meeting of the A.M.A. in June, 1950. They also prepared a pamphlet, now out of print, describing the known atlases up to that time. There were over a hundred listed, including second and third editions of some. Since then, a few more have been added.

The first atlas, that of A. C. Van Trigt, *De Speculo Oculi*, appeared in 1853. The author was 23 years of age and his thesis of 87 pages contained the first printed illustrations of the ocular fundus.

The atlases are in German, French, Spanish, Italian, and Japanese. C. H. Beard's *Ophthalmic Semeiology and Diagnosis*, published in 1913, is probably the first American atlas. Arthur J. Bedell's *Photographs of the Fundus Oculi* is certainly the first atlas with fundus photographs to be published in English. The *Atlas Fundus Oculi* by W. H. Wilmer, published in 1934, a very handsome one, is probably the best known in this country.

The history of atlases of ophthalmoscopy is an interesting one. The production of an atlas involves infinite pains on the part of the author who has the responsibility to choose the subjects, the artist who executes the detailed works of art, the engraver and printer charged with the difficult job of producing the proper color and the authentic sharpness of detail and, finally, the publisher who pays the freight of a very expensive business and who lives in hopes that the sale will at least partially reimburse him. Actually, the whole business is a labor of love, for in the end there may be little or no monetary reward and certainly not much kudos.

The student of ophthalmology gets an indescribable pleasure out of looking at the pictures and reading the legends in a well-prepared atlas. Old friends are recognized with a certain glee, and unknown pictures become the object of careful study with the hope that one will find the explanation for a peculiar fundus seen in a recent patient. There is also the gentle pleasure of trying to stump one's colleague by showing him a picture with the legend hidden.

The *Atlas* by Marchesani and Sautter fulfills all the criteria for a beautifully produced and instructive piece of work. The plates are truly magnificent and highly accurate. The legends, which are brief and to the point, in this edition are in English,

French and Spanish. The printers, Urban and Schwarzenburg of Munich, West Germany, have produced a masterpiece of their art.

There are seven chapters covering the subjects of comparative ophthalmoscopy (guinea pig, rabbit, dog, chicken); the normal fundus and its variations; physiologic variants and malformations (a most useful and novel chapter, although far from complete); diseases of the optic nerve; the retina, vessels, inflammations, blood dyscrasias, degenerations, detachment and tumors; diseases of the choroid, vessels, inflammations, degenerations, and tumors; and finally a chapter devoted to injuries.

Eighty dollars is a high price to pay for a book, although nothing when compared with the current price of a page from the Gutenberg Bible, or the first edition of Boswell's *Life of Johnson*. The price is not out of line if you are familiar with the current price of reproducing color plates. In fact the per copy cost of bringing out this atlas in this country could well be four or five times 80 dollars, probably even more. I consider it, therefore, a bargain and recommend it to all medical libraries and ophthalmic colleagues for study and reference.

There are two things I should like to see happen: (1) Dr. Rucker to bring out a new and up-to-date list and annotated catalogue of all atlases and (2) some one of our colleagues who is also a geneticist, wherever he may be, to bring out an atlas of ophthalmology devoted exclusively to congenital and developmental defects of the ocular fundus, the rarer the better.

Derrick Vail.

HYPERTENSION. (The First Hahnemann Symposium on Hypertensive Disease.) Edited by John Moyer, M.D. 774 pages and index. Philadelphia and London, W. B. Saunders Company, 1959. Price: \$14.00.

Certainly of prime interest to the ophthalmologist is the subject of hypertension and

arteriosclerosis, the state of which he is daily called upon to evaluate ophthalmoscopically. If he has an interest in the most current thought on the pathogenesis and treatment of vascular disease, he will do well to examine this large book, which is a compilation of papers and discussions from a symposium on hypertensive disease held at Hahnemann in December, 1958. Among the 91 participants are found the names of most of the clinicians and investigators who have contributed to a better understanding of hypertension. The volume is divided into parts dealing with (1) the pathology and clinical aspects of hypertension, (2) basic concepts of the etiology of hypertension, (3) pharmacology of hypertension and the sympathetic blocking agents, (4) the role of salt and diuretics and special problems in therapy, (5) the surgical approach and effect of therapy with a summary of recommendations for current therapy.

While the papers presented are noteworthy, most absorbing are the panel discussions which emphasize the disagreement between various authorities as to the basic nature of hypertension and arteriosclerosis. One might well quote Dr. Paton's final statement after 774 pages of discussion on hypertensive disease: "I have learned a great deal here this week but it does seem to me that our therapeutics reflect a lack of decisive knowledge about the etiology of hypertension."

Of particular interest to the ophthalmologist are papers by Bunt on "Retinal vascular changes in hypertension," and a study on the "Effect of blood pressure reduction on vascular changes in the eye," by Kirkendall and Armstrong. Utilizing serial fundus photographs and adopting a modified form of the classification proposed by the American Ophthalmological Society committee, the latter authors demonstrated an improvement in hypertensive changes in the retinal vessels with a drop in blood pressure but no improvement in arteriosclerotic changes.

William A. Mann.

REVERSIBLE RENAL INSUFFICIENCY. By Donald H. Atlas, M.D., Ph.D., and Peter Gaberman, M.D. Baltimore, Williams & Wilkins Company, 1958. 233 pages, references, index. Price: \$7.00.

The old term, uremic retinopathy, always connoted imminent exitus lethalis to the ophthalmologist. Although the terminology has changed and we now speak of hypertensive retinopathy, the poor prognosis of renal insufficiency is still a tenet of ophthalmology. In this monograph the authors show that there is a large group of acute renal diseases where the insufficiency is not only amenable to treatment but in many cases reversible.

Of even greater interest is Part II of this text which discusses chronic renal insufficiencies and shows that some of these are also reversible. Of particular concern to the ophthalmologist is the renal insufficiency associated with hyperparathyroidism and other hypercalcemic states. In these conditions calcium is frequently deposited in the conjunctiva and cornea and indeed may be the only clinical manifestation of the underlying condition. This section on the ocular manifestations of hypercalcemia is well worth reading.

David Shoch.

THE PRESERVATION OF EYESIGHT. By Sir Arthur Salusbury MacNalty, M.D., and consultants. Baltimore, Williams & Wilkins Company, 1959. 107 pages, index. Price: \$3.00.

This slim volume, like that by Derrick Vail on *The Truth About Your Eyes*, recounts in simple language the precautions necessary to maintain good eyesight. Elementary information is given briefly on the structure, nutri-

tion, and diseases of the eye. Among the foods listed as containing the vitamins essential for good sight are liver, eggs, butter, milk, cheese, mackerel, halibut, herring, cod-liver oil, vegetables, whole cereals, and yeast. Operation for squint is advised as soon as it is evident that nonoperative measures will prove unsuccessful. Lighting is well discussed. Weston found in the printing industry that when the illumination was increased to 25 foot-candles, the rate and efficiency of output equalled that obtained under daylight conditions. Classrooms should have windows of such size as to provide at each desk two to five percent of daylight. White paint reflects 75 to 80 percent of light; cream, ivory or primrose, 60 to 70 percent. In a most interesting chapter blindness is discussed in some detail. In Great Britain a blind person is legally but rather vaguely defined as a person who is unable to perform any work for which eyesight is essential.

Mining and quarrying take precedence even over the metal-producing and metal-working industries in severity of eye accidents. The virtual elimination of lead poisoning is one of the many triumphs of preventive medicine. The author, in discussing eye testing and spectacles, warns that "there is a certain danger in the initial use of bifocals, as it is easy to misjudge distances through them, and this sometimes causes a disastrous fall in elderly people." The final chapter, a masterly recapitulation of the important points to be remembered, deserves the widest possible circulation.

This excellent book, though not unique in its field, should be of interest and value to your wife, your secretary, and the laity in general.

James E. Lebensohn.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Calmettes, Deodati, Huron, and Bechac. **A study of the depth of the anterior chamber. Physiologic variations and variations with ametropia.** Arch. d'opht. 18:513-542, July-Aug., 1958.

The authors note that precise methods of estimating the depth of the anterior chamber have only recently been available. With such methods they undertook a study of physiologic variations according to age, sex, refractive state, accommodation, and the cephalic morphology of the individual. After a comparative study of different photometric and optical methods of examination, they decided that the apparatus of Jaeger afforded great advantages by virtue of its simplicity and ease of reading. They reached the following conclusions: 1. In emmetropes the depth of the anterior chamber increased regularly during growth and reached a maximum in young adults from 20 to 30 years old. After this age the depth diminished coincidentally with thickening of the lens. Women consistently showed lower figures. There were wide variations accord-

ing to cephalic proportions. 2. In ametropes the depth of the anterior chamber increased when hypermetropia passed into myopia. 3. In modifications of accommodation, either physiologic or produced by drugs, variations in the depth of the anterior chamber varied too greatly from individual to individual to have any significance. (2 figures, 2 curves, 7 tables, 49 references)
P. Thygeson.

Cohen, Adolph I. **Electron microscopic observations on the lens of the neonatal albino mouse.** Am. J. Anat. 103:219-246, Sept., 1958.

The capsule, the lens and related structures of the eye of the neonatal albino mouse have been studied with the electron microscope.

The capsule is laminated and composed of about 40 membranes of about 300 to 400 Å in thickness. The total thickness, including spacings, is 2.5 μ near the lens equator.

The lens epithelial cells and cortical cells are rich in mitochondria and show occasional granular ergastoplasmic complexes. Numerous interdigitated cell processes are observed, largely on the radial

borders of the epithelial cells and on all surfaces of the cortical cells.

Vacuoles observed in a middle zone of the lens have proved to be intercellular spaces which are possibly inter-communicating. These lacunae reach the subcapsular region posteriorly with the middle zone of the lens and run anteriorly in this layer for about two-thirds of the anterior-posterior diameter.

Cells of the lens core show preservation of membranes but dense clumping of cytoplasmic material. The rare nuclei encountered in this zone, however, show no nucleoplasmic clumping.

The tunica vasculosa capillaries frequently have a double basement membrane which touches and probably fuses with the lens capsule.

No organized zonule fibers were seen in the neonatal mouse although wisps of fibers were occasionally encountered in the vitreous. The adult mouse, however, has a well established zonule system, the fibers of which occasionally appear to have a structural periodicity. (15 figures, 29 references) Author's summary.

Dejean, C. **Embryology and teratology of the eye. Part II of the report of 1958.** Bull. et mém. Soc. franç. d'opht. 71:318-327, 1958.

The development of the primary vitreous and of the zonula and their origin from the primitive retina and lens are described and the unfolding of the secondary vitreous with its unique consistency discussed. The formation of the lens, the sources of the retrolenticular and anterior vascular sheaths are the subject of successive chapters. Anomalies in those structures are discussed in a separate part of this treatise. Alice R. Deutsch.

Gregersen, E. **Structural variations of the crypts and "bridge trabeculae" of the human iris.** Acta Ophth. 37:119-124, 1959.

Two types of crypts occur in the hu-

man iris: uncovered ones, completely open toward the anterior chamber, and "net-covered" crypts which are covered by a delicate, fibrillar, non-nucleated net-like tissue. The floors of the uncovered crypts consist of a similar network of the same mesh size. Tissue protrusions and bridges of trabecular iris tissue are also described in detail. (5 photomicrographs, 10 references) John J. Stern.

Leplat, G. **Embryology and teratology of the eye. Part I of the report of 1958.** Bull. et mém. Soc. franç. d'opht. 71:311-318, 1958.

The development of the uvea, sclera, lacrimal apparatus, external eye muscles, lids and orbits are the topic of this, the first part of the "annual report." Chronological and mechanical factors and their effect on the normal development of the eyeballs had been studied by the author for more than 25 years. The causes for a possible disturbance of the normal development were investigated also. Teratology should not be merely an enumeration of hereditary malformations but should equally include exogenous elements, such as physical, chemical, infectious and nutritional agents. There are many facultative noxious agents. They are not specific, however, and their more or less damaging effect depends entirely on the stage of development and the length of time of exposure. The importance of a thorough understanding and correct interpretation of the contributing factors was stressed. The thought that certain groups of congenital abnormalities are preventable is very encouraging. Alice R. Deutsch.

O'Rahilly, R. and Meyer, D. B. **Embryological study of the chicken eye.** Bull. et mém. Soc. franç. d'opht. 71:355-358, 1958.

In 1951, 46 stages in the development of the chicken embryo were established by Hamburger and Hamilton. These

stages were based on morphologic details and not on the length of incubation. In the present study many serial sections of chicken eyes were examined in order to correlate exactly the morphogenesis of the eye with the external stages of the embryo. Observations of this kind should prove of great value for experimental embryology, teratogenesis and histochemistry of the developing eye. (2 figures, 3 tables)

Alice R. Deutsch.

Speakman, John. **Aqueous outflow channels in the trabecular meshwork in man.** *Brit. J. Ophth.* 43:129-138, March, 1959.

Freshly enucleated eyes were rapidly fixed and Schlemm's canal opened under an operating microscope to expose the fine drainage channels which open into its lumen. The uveal meshwork consists of dense bundles of fibers which terminate on one side of the filtration angle and on the other side are firmly attached to the connective tissue of the iris root and to the ciliary muscle. It is obvious that through this meshwork the aqueous could flow very easily. Within the corneoscleral meshwork the connective tissue closer to the canal becomes thicker and seems to become more porous but the porosity proves to be a series of intercommunicating channels about 10 μ in width which enter into the trabecular wall of Schlemm's canal. Since these openings are so minute a disturbance of their cell linings can account for the resistance to aqueous outflow in chronic glaucoma. (12 figures, 6 references)

Morris Kaplan.

Speakman, John. **Endothelial cell vacuolation in the cornea.** *Brit. J. Ophth.* 43:139-146, March, 1959.

Enucleated human eyes were studied under the phase microscope and compared with cat and rabbit eyes prepared in different manners. It was determined

that the vacuolations of the endothelial cells lining the trabecular wall of the canal may vary in diameter but are a constant feature. These cells show the typical hexagonal pattern but this is usually distorted by the usual formalin fixation which in itself may be the cause of the vacuolation. More rapid fixing techniques were used in cat and rabbit eyes. There was no vacuolation and the usual hexagonal cell arrangement remained intact. These postmortem changes are probably due to imbibition of fluid. (10 figures, 13 references)

Morris Kaplan.

Wanko, T. and Gavin, M. A. **The fine structure of the lens epithelium.** *A.M.A. Arch. Ophth.* 60:868-879, Nov., 1958.

Lenses of guinea pigs, rats, rabbits, and monkeys were used for electron microscopy of the epithelium. A number of interesting cytological features were noted. The individual cell was irregular in shape and had numerous processes and interdigitations which apparently allow for the plasticity during accommodation. The anterior cell membrane structure suggests a surface activity comparable in some ways to capillary endothelium. (11 figures, 29 references)

G. S. Tyner.

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Jones, B. R., Collier, L. H. and Smith, C. H. **Isolation of virus from inclusion blennorrhoea.** *Lancet* 1:902-905, May 2, 1959.

Viruses have been isolated from a woman with inclusion cervicitis and from a baby with inclusion blennorrhoea. In their morphology and staining reactions these agents resemble the viruses of trachoma and other members of the psittacosis-lymphogranuloma group, with whom they share a complement-fixing group antigen. One of these agents has been inocu-

lated into baboons, and has induced severe inclusion conjunctivitis. This is good presumptive evidence of its etiologic relation with this disease. (5 figures, 1 table, 21 references) Authors' summary.

Miettinen, Pentti. **Tuberculous eye diseases in BCG vaccinated individuals.** Acta Ophth. Supplementum 48, 1958.

Of 1,926 patients with certain or probable tuberculous eye disease, 15 percent had been BCG vaccinated; 62 patients had phlyctenulosis, 69 iritis, choroiditis or uveitis, and 18 had other lesions. Each case was evaluated individually. The most important datum is that sensitivity tests had been done after only a negligible number of vaccinations; these vaccinations have therefore not been done *lege artis*. Tuberculous disease or disease which was probably tuberculous was present in only two percent of the correctly vaccinated patients. No difference was observed in the course of the disease in vaccinated and nonvaccinated patients. (31 tables, 168 references)

John J. Stern.

Segal, P., Ruszkowski, M. and Burawski, J. **Electrophoresis of aqueous in experimental iritis in rabbits.** Klinika Oczna 28:315-320, 1958.

Aqueous in experimental iritis in rabbits was checked for possible differences depending on etiology of the disease. It was found that in severe iritis there was considerable concentration of albumin in the aqueous and small amount of globulin, regardless of etiology. With the decrease of inflammation there was a decrease in albumin and an increase in globulin. When the irritant was a piece of iron, the mechanical and chemical action was causing slowing down of the shift toward globulin despite clinical improvement. In severe iritis the composition of the aqueous approaches the serum, suggesting damage to the blood-

aqueous barrier. During convalescence the composition of the aqueous suggests production of antibodies by the tissues themselves. The inflammatory reaction in rabbits cannot be completely compared to human uveitis. (2 figures, 4 tables)

Sylvan Brandon.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Balik, Josef. **The excretion of urea in the tears.** Acta Ophth. 37:103-111, 1959.

The urea concentration in the tears increases with higher tear secretion in a parabolic, not a linear curve, and is independent of the blood urea level. The findings indicate that the urea is derived not only from the blood but also from the amino acid metabolism of the tear gland and the conjunctival mucous glands. (2 figures, 2 tables, 3 references)

John J. Stern.

Bernoulli, René. **Experiences with the mydriatic "Roche."** Ophthalmologica 137: 86-95, Feb., 1959.

In this mydriatic (called MyRo for short) a pyridine derivative is linked with an amide of tropic acid. Its effects upon the human eye are characterized by rapid onset and short duration of maximal mydriasis and fairly profound cycloplegia. (1 figure, 1 table, 3 references)

Peter C. Kronfeld.

Boros, B. and Takáts, I. **Examination of hydergin effect on isolated iris tissue.** Szemeszet 96:1-5, 1959.

The authors examined the effect on sphincters taken from 24 cats, of hydergin alone and the combined effect of hydergin and prostigmin, to determine the influence of the drug on the contraction-enhancing effect of acetylcholine and on the relaxing effect of adrenalin. The highest concentration of hydergin, namely its dilution 10^{-6} , did not act on the sphincter,

and it did not increase the contracting effect of 10^{-6} prostigmin. Hydergin did not show a parasympatholytic effect either, since it did not inhibit the acetylcholin-induced (10^{-5}) contraction. In several experiments, the relaxing effect of 10^{-5} adrenalin has not been neutralized by 10^{-6} hydergin. Gyula Lugossy.

François, J. and Rabaey, M. **High tension electrophoresis of the soluble lens proteins.** Bull. Soc. belge d'opht. 119:474-491, 1958.

The various types of electrophoresis and their significance for the separation of lens proteins are discussed. Microelectrophoresis on gelatin and microelectrophoresis under high tension were found to be more revealing than paper electrophoresis. Pherograms of various animals are shown and analyzed. Paper electrophoresis of the lens of a human infant has shown four different protein fractions while 10 different fractions were found with the electrophoresis on gelatin at 25°C and 13 fractions were found at a comparatively low temperature and high pressure. A similar increase in fractions was found in the pherograms of a 35-year-old man. The purity or impurity of the so-called basic proteins and their relation to the various fractions, the modifications of the composition and arrangements of proteins during life and during the periods of lens opacification, and the diverse qualities of lens proteins in different animals are recognized. (10 figures, 8 tables, 18 references)

Alice R. Deutsch.

Graymore, Clive. **In vitro swelling of the kitten retina induced by sodium fluoride inhibition.** Brit. J. Ophth. 43:40-41, Jan., 1959.

In previous experiments with rat retinas it has been shown that intravitreal injection of sodium fluoride causes edema of the retina which in turn results in

vaso-obliteration similar to that induced by hyperoxia. This study is designed to show that the kitten retina will respond in vitro to sodium fluoride as does the retina of the rat. The retinas were incubated in fluid containing the fluoride and their weight afterwards indicated a significant increase in the ratio of the treated retinas to the untreated. (1 table, 5 references) Morris Kaplan.

Graymore, Clive. **Metabolism of the developing retina. I. Aerobic and anaerobic glycolysis in the development of rat retina.** Brit. J. Ophth. 43:34-39, Jan., 1959.

The effect of hyperoxia on the immature retina with resultant obliteration of vessels is well known and it has also been shown that the injection into the vitreous of such metabolic inhibitors as sodium fluoride and sodium iodoacetate will produce the same obliteration of vessels; neither has an adverse effect on the mature retina.

The total retinas of rats less than seven days of age and more than seven days were subjected to aerobic glycolysis and to anaerobic glycolytic activity during the second week of life. Increased activity is coincident with the beginning of normal use of the retina which is indicative of appreciable metabolic change between the immature and the mature retina. (2 figures, 2 tables, 19 references)

Morris Kaplan.

Graymore, C. and Tansley, K. **Iodoacetate poisoning of the rat retina. I. Production of retinal degeneration.** Brit. J. Ophth. 43:177-185, March, 1959.

It has been well established that retinal degeneration can be caused in various laboratory animals by intravenous injection of sodium iodoacetate. This has been difficult in the rat but in this study it was accomplished by giving a single dose of 40 mg. per kg. in 10 cc. of saline solution given over a period of 20 minutes. The

animals were killed seven days later and the eyes were fixed and stained by several methods. In none of the animals were evidences of retinal degeneration found. When the dose was divided into two doses of 30 mg. per kg. there was moderate retinal damage. When the iodoacetate was given with sodium malate, the destructive effects of the iodoacetate were enhanced appreciably. (3 figures, 4 tables, 11 references) Morris Kaplan.

Gregersen, E. **Elimination of high- and low-molecular Dextran fractions from the anterior chamber and iridic stroma of rabbit eyes. Histologic study following washing of the anterior chamber with solutions of Dextran.** *Acta Ophth.* 37:35-48, 1959.

After varying periods of perfusion of the anterior chamber of rabbits with high- and low-molecular fractions of the polysaccharide Dextran the eyes were enucleated and Dextran was demonstrated by PAS staining. All Dextran solutions used gave an abundance of the substance in the iris vessels, while only little or none was found in the outflow channels of the angle. It is concluded that under existing experimental conditions elimination of Dextran takes place mostly by way of the iris vessels. The greater part of the substance, regardless of concentration, disappears from the eye within an hour or two. (2 figures, 19 references)

John J. Stern.

Hofmann, H. and Lembeck, F. **A comparison between the zonulolytic effect of alpha-chymotrypsin and trypsin.** *Klin. Monatsbl. f. Augenh.* 134:316-322, 1959.

Experiments were done on the eyes of cattle in which the time was measured which was necessary to detach the zonula fibers from the lens capsule when a constant pressure is exerted. A few calf eyes and human eyes could also be tested. It was found that trypsin was three times

as effective as alpha-chymotrypsin. Trypsin has since then been used successfully for cataract extractions. (2 figures, 2 tables, 8 references) Frederick C. Blodi.

Huggert, A. **Studies on the water of the crystalline lens. II. The extracellular space of the cattle lens, measured in vitro.** *Acta Ophth.* 37:26-32, 1959.

The extracellular space of the cortex was found to occupy 20 to 30 percent; that of the nucleus 12 to 20 percent when examined with Na^{24}Cl and NaBr^{82} . (5 figures, 14 references) John J. Stern.

Huggert, A. and Odeblad, E. **Studies on the water of the crystalline lens. III. Proton magnetic resonance studies.** *Acta Ophth.* 37:93-102, 1959.

The proton magnetic resonance technique was used to measure the water content of human and rabbit lenses. The line width in young and old rabbit lenses was the same for the cortex, but for the nucleus it increased considerably with age. The position of the signal was shifted slightly toward the higher magnetic field for the nucleus compared with the cortex. The same findings were made in human lenses. A cataractous change in the cortex appeared to be accompanied by a broadening of the line. (9 figures, 3 tables, 7 references) John J. Stern.

Krag, S. J., Garron, L. K., Feeney, M. L. and McEwen, W. K. **Perfusion of human eyes with latex microspheres.** *A.M.A. Arch. Ophth.* 61:69-71, Jan., 1959.

Twelve eyes were perfused with graded latex microspheres under relatively physiologic perfusion pressures. Particles 1.2 μ in diameter and smaller easily passed through the canal of Schlemm, 1.8 μ and 3.0 μ particles encountered some obstruction, and particles 5.6 μ did not traverse the canal. (1 figure, 1 table, 8 references)

Irwin E. Gaynon.

Krueger, K. E. and Janert, H. **Experiences with a new cycloplegic and mydriatic.** *Klin. Monatsbl. f. Augenh.* 134:417-421, 1959.

The authors tried the diethyl homologue of cyclogyl. A 1-percent solution proved to be an excellent cycloplegic and mydriatic. (2 tables, 9 references)

Frederick C. Blodi.

Kurus, Ernst. **The histochemical proof for zinc as a trace element in the eye.** *Klin. Monatsbl. f. Augenh.* 134:338-350, 1959.

Zinc has gained interest as it is the metallic component of the enzyme carbonic-anhydrase. A histochemical method was used on freshly enucleated eyes. Normal eyes did not give a positive reaction. In arteriosclerosis, thrombosis, and absolute glaucoma zinc could be found around the blood vessels and in the rods and cones. It was also found in uveal vessels, ciliary body and choroidal melanomas. (3 figures, 24 references)

Frederick C. Blodi.

Larsen, Godfred. **The hyaluronic acid in the rabbit vitreous body.** *A.M.A. Arch. Opth.* 60:815-825, Nov., 1958.

The author reports the increase of hyaluronic acid in rabbit vitreous under the influence of cortisone and thyroidectomy plus thyrotropin. The response to thyroxin is a decrease of hyaluronic acid. A correlation between the relative viscosity and content of hyaluronic acid shows that the specific viscosity remains unchanged in the animals which were given cortisone but is increased in those which were thyroidectomized and given thyrotropin and those treated with thyroxin. (10 figures, 6 tables, 28 references)

G. S. Tyner.

Lucas, D. R. and Newhouse, J. P. **Action of metabolic poisons on the isolated retina. Relation of histological to bio-**

chemical lesions. *Brit. J. Ophth.* 43:147-158, March, 1959.

The cytological effects of sodium iodoacetate (NaIA) and other inhibitors upon the isolated rabbit retina, incubated under oxygen in saline media for one hour, were investigated. NaIA caused retinal damage at lower concentrations than are necessary in vivo; injury was not confined to the visual cells, the bipolar and ganglion cells sometimes being simultaneously affected. Other inhibitors, particularly the thiol reagents, were in vitro more cytotoxic than NaIA, though without effect parenterally. The degree of damage inflicted by any agent did not appear to be related to the extent of glycolytic inhibition caused. No substance tested, even anti-glycolytic agents such as NaIA or NaF, was destructive until concentrations were used at which independent respiratory inhibition also occurred. Fluorodinitrobenzene, which entirely suppresses respiration but has little effect on glycolysis, was notably destructive. It is suggested that the cytotoxicity of the thiol reagents depends on their ability to inhibit simultaneously many thiol-dependent enzymes rather than upon suppression of any specific retinal process. (12 figures, 3 tables, 18 references)

Authors' summary.

Neubauer, H., Eggstein, M. and Kalusky, H. E. **Serum cholesterol in arteriosclerotic fundus changes.** *Klin. Monatsbl. f. Augenh.* 134:330-338, 1959.

This study is based on 166 carefully studied patients of whom 75 had definite arteriosclerotic changes in the fundus and 78 had a fundus normal for their age. There was no significant difference in serum cholesterol level in the two groups. (2 figures, 1 table, 17 references)

Frederick C. Blodi.

Nover, A., Berneaud-Kötz, G. and Elben, A. **Pharmacologic influence on the**

experimentally decreased blood-aqueous barrier. *Klin. Monatsbl. f. Augenh.* 134: 195-205, 1959.

The blood-aqueous barrier was measured by the speed with which fluoresceine appeared in the anterior chamber after an intravenous injection. This barrier was lowered in a series of rabbits by sensitizing them to a foreign protein (horse, hog or cattle). The maximal effect was reached after two months of bi-weekly subcutaneous injections. Cortisone (applied locally or systemically) and calcium increased the barrier of these sensitized animals to and above normal values. Neither drug influenced the barrier of normal, untreated animals. (8 figures, 39 references)

Frederick C. Blodi.

Raoult, Jean. **Clinical measurement of resistance to passage of the aqueous.** *Arch. d'opht.* 18:657-661, Sept., 1958.

The author discusses the technique of measuring aqueous outflow in clinical practice. He considers the tonometer of Schiøtz satisfactory and illustrates the method of measurement with graphs and patients' records. He concludes that tonography has an important place in the practice of ophthalmology. (2 figures, 1 table)

P. Thygeson.

Sachsenweger, R. and Lukoff, L. **Animal experiments on the consequences of a surgical occlusion of vortex veins.** *Klin. Monatsbl. f. Augenh.* 134:364-373, 1959.

The experiments were done on dogs and rabbits. The veins were ligated or coagulated. The intraocular pressure increased only when all four veins were ligated. The entrance of fluoresceine was retarded in the operated animals. In histologic sections the choroid was hyperemic, the retina was sometimes locally detached and hemorrhages could be found. (9 figures, 11 references)

Frederick C. Blodi.

Takki-Luukkainen, I.-T. and Miettinen, T. **Presence of sialic acid and hexosamine in proteins of the aqueous humor.** *Acta Ophth.* 37:138-142, 1959.

The patterns of aqueous and serum proteins seem to be different. Sialic acid is present in amounts ranging from 0.18 to 0.38 mg. percent, hexosamine from 0.26 to 0.51 mg. percent. (3 figures, 1 table, 13 references)

John J. Stern.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Benoit, Alain. **Biotypology of the myopic man.** *Arch. d'opht.* 18:734-752, Oct.-Nov., 1958.

In a statistical and anthropometric study of 38,670 recruits of the Third Military Region (1937), the records of 1,511 myopes were segregated and all elements regarded as of possible significance in the genesis of myopia were assembled for analysis. The cases were analyzed according to 1. frequency and distribution of myopia, 2. relation between myopia and cultural and intellectual development, 3. relation between myopia and somatic development, and 4. relation between myopia and geographic distribution. The author concludes that it is necessary to separate low myopia from high myopia. He considers high myopia (above 7 diopters) an anomaly with pathologic and degenerative features, and low myopia as related to the evolution of the human species. The role of close work in the occurrence of myopia could not be assessed. The author considers that myopes tend to fall into a particular physical type, being taller and thinner than their fellow emmetropes or hyperopes. (9 figures, 7 tables, 26 references)

P. Thygeson.

Cardell, Magor J. D. **Bifocal trial lenses.** *Brit. J. Ophth.* 43:116, Feb., 1959.

A set of trial lenses of the bifocal type, having plano above, and with the usual

reading additions below, are described. The usefulness of the bifocal lens can be demonstrated to the patient by means of these lenses. (1 figure)

Irwin E. Gaynon.

Dreyer, V. **Visual contrast thresholds. II. The influence of different areas of negative stimuli.** *Acta Ophth.* 37:148-158, 1959.

The following conclusions are drawn:

1. The contrast thresholds for negative stimuli cannot be expressed as a simple function of the area of stimulus.
2. The contrast thresholds for negative and positive stimuli do not follow the same laws.
3. In the case of negative stimuli, there is a critical minimum visual angle (under which the contrast thresholds are dependent on the area of the stimulus) only with background luminances less than or equal to about 80 cd/sq.m. In this case the critical minimum visual angle is about 2.5'.
4. In the case of negative stimuli, the Fechner fraction is constant above a critical minimum background luminance (about 80 cd/sq.m.), and remains unchanged even when the visual angle of the stimulus is decreased from about 20' to about 1'.
5. Above this critical minimum background luminance, there is a range for which the Weber-Fechner law is valid for all visual angles of negative stimuli. (2 figures, 5 references)

John J. Stern.

Falkowska, Zofia. **Testing of acquired color disturbance with Pulfrich's photometer.** *Klinika Oczna* 28:269-281, 1958.

The author used Pulfrich's photometer and found achromatic areas when the light intensities used were low. In more severe conditions only medium light intensities permitted correct recognition of colors though areas of achromatopsia and dichromatopsia were present. Other pathologic symptoms of color vision

were: changes in thresholds, wavy appearance of colors and light, and prolonged afterimages. In diseases of the optic nerve first changes appear in the blue end of the spectrum spreading later over the whole length of it. Macular degeneration affects red color first. In optic neuritis color vision may be affected before visual acuity starts decreasing. Also after complete recovery some defects in color vision may remain. In some cases of unilateral neuritis abnormalities in color vision could be detected with Pulfrich's photometer in the other eye. The author feels that it is more sensitive than the Ishihara plates. It also permits quantitative measurement which is useful in determining the progress of the disease. Among 177 patients tested, 25 were found to have optic neuritis, 13 papilledema, 26 hemianopsia, 34 optic atrophy, 14 multiple sclerosis, 15 tabes, 14 glaucoma, and 10 central retinitis. (8 figures, 49 references)

Sylvan Brandon.

Marquez, M. **Historical evolution of ideas on skiascopy, its present state and true mechanism.** *Ann. d'ocul.* 191:869-930, Dec. 1958.

This review article is divided into two parts. Part I is a historical review of retinoscopy or skiascopy. Cuignet was apparently the first to discover the movement of shadows in the pupil and its relationship to refractive error. Landolt then produced the theoretical background for this technique and Parent used correcting lenses for the first time.

Part II describes the present use of retinoscopic devices. The various mirrors are described and the principles involved with the use of each elaborated. The author concludes that skiascopy has a great practical value and is of great exactness but that subjective refraction is still the last word. (29 figures, 95 references)

David Shoch.

Verain, A. **Binocular vision and appreciation of distances.** Arch. d'opht. 18:753-755, Oct.-Nov., 1958.

The author discusses the role of binocular vision in depth perception with particular reference to convergence. He has devised a new test for depth perception and reports the results of a pilot test in 12 subjects. He considers the results sufficiently encouraging to warrant further exploration.

P. Thygeson.

5

DIAGNOSIS AND THERAPY

Abramowicz, Ignacy. **Transillumination in choroidal neoplasm.** Klinika Oczna 28:239-242, 1958.

By directing the light through the pupil the outline of the tumor may be seen on the scleral wall. Directing the light through the sclera one can see the red reflex of the opposite wall of the eye; a mass in the way of the light will decrease the intensity of the reflex. Another method is to apply the light to the scleral wall and observe the intensity of the light reflection within the pupil. To transilluminate deeper parts of the eye the conjunctiva must be incised and one of the muscle tendons separated from its attachment. Transillumination through the pupil then gives good results. Observation in the half light in direct ophthalmoscopy, as described by Reese, is also mentioned. (7 figures, 5 references)

Sylvan Brandon.

Boeke, W. **Cortisone therapy in Hara's disease.** Klin. Monatsbl. f. Augenheilk. 134:407-410, 1959.

A 54-year-old woman with bilateral, inflammatory retinal detachment improved promptly on systemic cortisone therapy. (7 references)

Frederick C. Blodi.

Czerwinska, Wlodzimiera. **Ultrasound in ophthalmology.** Klinika Oczna 28:261-267, 1958.

The basic effect of ultrasounds on tissues is cavitation. The action of ultrasounds is thermal and mechanical and depends on the wave frequency. It is not transmitted uniformly and the vegetative nervous system has considerable influence on it. The dosage and timing is described. (17 references)

Sylvan Brandon.

Erdbrink, W. L., Edwards, J. E., Crowe, W. W., Johnson, H. S., Cooke, S. L. and Richmond, R. W. **Orbital fractures.** A.M.A. Arch. Ophth. 61:55-67, Jan., 1959.

The patient presenting a "black eye" should be suspected of having orbital trauma. Examination includes visual acuity, external examination, funduscopy, palpation of orbit, ocular motility and X-ray study. The patient's ability to open and close his mouth should be tested.

Proper treatment includes replacement of bony parts to maintain facial contour, maintenance of vision and the avoidance of diplopia, maintenance of function and occlusion of teeth, and the reduction of facial scars and psychic distress. Surgery should be performed within two weeks after injury. The open and closed methods of reduction are explained, with before-and-after pictures. (14 figures, 22 references)

Irwin E. Gaynon.

Espildora Luque, C. **Chemotherapeutic treatment of palpebral cancer.** Arch. chil. de oftal. 15:49-53, Jan.-June, 1958.

The author reveals briefly the characteristics of a new Bayer preparation, E 39, which chemically is an ethylen-amino-quinine, and which had been found useful in the treatment of leukemias. This product had been used by Pillat for the treatment of palpebral cancer by in situ injections of the drug. The author presents the case history of a patient with histologically proven basal cell epithelioma which completely disappeared with three injections

of 6 mg. E 39 given over a 20-day period. The leucopenia which occurs with overdosage of this drug can be treated with small blood transfusions, but was not noted in the eyes treated with intratumoral injections.

The patient was discharged with a completely well-healed skin and no cicatricial retractions and without any observable recurrence, but the author points out the too short observation period for this patient. He feels that more time and patients are needed for a complete evaluation. (2 figures, 2 references)

Walter Mayer.

Festing, Salezy. **Tight dressing in prevention and treatment of postoperative complications of eye wounds.** *Klinika Oczna* 28:283-292, 1958.

Loss of anterior chamber after cataract surgery usually is due to a leaking wound. Anterior chamber hemorrhages are also due to poor apposition of wound edges. Sutures are not completely effective in holding the edges together. Sometimes the aqueous leaks through the suture canal. The author advises the use of a mild pressure dressing, which is applied on the second or third day after the operation, for prevention, or as soon as the anterior chamber becomes flat. (1 figure, 4 references)

Sylvan Brandon.

Gordon, Dan M. **Therapeutic habits in ophthalmology.** *A.M.A. Arch. Ophth.* 61: 72-78, Jan., 1959.

The results of a survey indicate that the steroid therapy employed by most ophthalmologists has been "too little and too late." If dosage adequate to suppress the disease is not used in the very beginning, good control is impossible. The initial dosage must be continued as long as necessary to secure improvement and then tapered off and discontinued only when the disease process is gone. (7 tables)

Irwin E. Gaynon.

Gundersen, Trygve. **Conjunctival flaps in the treatment of corneal disease with reference to a new technique of application.** *A.M.A. Arch. Ophth.* 60:880-888, Nov., 1958.

The indications for use of conjunctival flaps are outlined as well as the objections to their use. The author's technique for flap operations is described. It consists essentially of exposure of the entire upper bulbar conjunctiva by a traction suture placed through the upper corneal limbus, incision through the upper conjunctiva to make a conjunctival bridge extending from the fornix to the upper limbus, complete peritomy and then suturing the bridge into position with a fine silk suture. (6 figures, 13 references)

G. S. Tyner.

Karpe, Gösta. **Indications for clinical electroretinography.** *A.M.A. Arch. Ophth.* 60:889-896, Nov., 1958.

The technique of clinical electroretinography is briefly described. The test does not give information on isolated retinal lesions, but on the response of the retina as a whole. The following entities in which electroretinography gives valuable diagnostic and prognostic aid are listed: circulatory disturbances of the retina, siderosis, retinal detachment, tapetoretinal degeneration, and retrolental damage. (14 figures, 3 tables, 30 references)

G. S. Tyner.

Lama, G. **Subconjunctival placenta therapy.** *Arch. chil. de oftal.* 15:54-55, Jan.-June, 1958.

The author presents two case histories of patients who benefited from subconjunctival implantation of placental tissue. However, they refused to have further implantations and for this reason the author developed a placental extract, which could be easily injected subconjunctivally. This seemed to be just as

beneficial as the implantation of placental tissue.
Walter Mayer.

Norbis, A. and Malbran, E. **Biomicroscopy of the fundus.** Arch. oftal. Buenos Aires 33:213-228, Oct.-Nov., and 245-268, Dec., 1958.

This is a well-documented review of the subject of slitlamp examination of the vitreous and fundus. In addition to a description of the technique used, a critical evaluation of the normal and pathologic aspects of the deep ocular structures, with special reference to those found in cases of retinal detachment, is presented, together with the results of considerable personal experience and with a comprehensive bibliography. (27 references)
A. Urrets-Zavalía, Jr.

Nover, A. and Salm-Salm, E. Z. **Eye changes as initial symptoms of a systemic disease.** Klin. Monatsbl. f. Augenh. 134: 323-329, 1959.

Four patients are described who had a lid tumor. Biopsy revealed sarcoidosis in one, tuberculosis in one and lymphogranuloma in two. (6 figures, 48 references)
Frederick C. Blodi.

Ross, Milton G. **Use of the Schepens binocular indirect ophthalmoscope in operations.** A.M.A. Arch. Ophth. 60:947-949, Nov., 1958.

The author describes a method for using the instrument during retinal detachment surgery without wearing it continuously throughout the operation. The head band is detached and the operator holds the ocular portion in his hand. (2 figures, 2 references)
G. S. Tyner.

Ruben, C. Montague. **Operation-table head-pillow.** Brit. J. Ophth. 43:117, Feb., 1959.

A pillow made of laminated latex and covered by anti-static rubber is described. It provides stability, supports the curvature of the cervical spine, supports the

surgeon's arms, fits most patients, and provides space lateral to the patient's head for instruments. (1 figure)

Irwin E. Gaynon.

Schiff-Wertheimer, S. and Loisillier, M. F. **Notes on the realization of a photographic slitlamp.** Arch. d'opht. 18:833-835, Dec., 1958.

The authors describe their photographic slitlamp manufactured by M. Kirchen, Paris, and present three illustrative color photographs showing vitreous strands, synchysis scintillans, and organization of the anterior vitreous. The mechanical features of the apparatus are shown by photographs and drawings. (3 figures, 3 colored photographs)

P. Thygeson.

Sumner, S. S. **A new needle holder.** Brit. J. Ophth. 43:118-119, Feb., 1959.

A new needle holder is described which is based on the principle that finger movements are more delicate than hand movements. It is not suitable for general use but is valuable when fine sewing is needed, as in preplaced corneoscleral sutures. (3 figures)
Irwin E. Gaynon.

Vancea, P. and Lazarescu, D. **The uveo-meningo-encephalitis syndrome.** Arch. d'opht. 18:652-656, Sept., 1958.

The authors report a case of Vogt-Koyanagi disease in a man of 28 years, with onset with fever, bilateral acute uveitis, and optic neuritis. There were typical symptoms of meningeal irritation and cells in the spinal fluid. Intensive treatment with vitamins, antibiotics, and steroids did not modify the disease which eventually regressed, the vision returning to 0.25. The authors discuss the relationship between the syndromes of Vogt-Koyanagi and Harada, and conclude that the two are variants of the same disease entity: uveo-meningo-encephalitis. (12 references)
P. Thygeson.

Vellieux, M., Oliveau, G. L.-B. and Aubry, M. **African ocular onchocercosis.** Arch. d'opht. 18:543-554, July-Aug., 1958.

The authors note that African onchocercosis transmitted by *Onchocerca volvulus* is found generally in the intertropical zone between 20° latitude North and 20° latitude South. In certain regions the frequency and severity of the disease is such as to menace habitability. The authors discuss the epidemiologic features of the disease, including the nature and flight habits of the intermediate host, *Simulium damnosum*. They note that the disease usually induces irreversible degenerative changes in the iris, ciliary body, retina, and choroid, leading to economic blindness, and that the usual treatment with notezine (a derivative of piperazine) and moranyl is unsatisfactory. The campaign against the disease must therefore be directed against the vector. The authors describe the results of an epidemiologic study of 37,382 natives of the territory of Haute Volta of whom 14,333 were affected. They note that the infection rate was in direct proportion to the proximity of the population to water and to the accompanying exuberance of vegetation. They found that the most important diagnostic sign was the presence of nodules (oncocercomas), and that dermal biopsies had greater diagnostic value than dermal scrapings. It is of interest that with the slitlamp they found microfilaria in the anterior chambers of 27 percent of positive cases. (1 figure, 3 tables, 20 references) P. Thygeson.

Voutilainen, A. **Radioactive strontium in ophthalmic treatment.** Acta Ophth. 37: 180-187, 1959.

Radioactive strontium was used in the treatment of 17 patients with corneal disturbances, among them keratitis of various origin, spring catarrh, ulcus serpens and epithelial down-growth. The aim was to obliterate corneal vessels and to pre-

vent inflammation or opacities. A favorable result was obtained in 70 percent, an excellent one in 35 percent. One case of postoperative epithelial downgrowth was arrested, another one retarded. (5 figures, 1 table, 21 references)

John J. Stern.

Weigelin, E. and Menke, C. **Experiences with the two-pivot implant of Arruga-Moura-Brazil.** Klin. Monatsbl. f. Augenh. 134:305-313, 1959.

Two needles are attached to this implant which are first covered with tissue of Tenon's capsule and conjunctiva. After a few weeks the sharp needles break through the conjunctiva and the prosthesis can be attached to them. The implant has four tunnels for the rectus muscles. Silk should be used in the muscles for suturing so that a dense scar tissue is formed. Such an implant was extruded in seven of 75 patients. (5 figures, 2 tables, 7 references) Frederick C. Blodi.

Zeller, Robert W. **Multiple targets in visual field examination with a tangent screen.** A.M.A. Arch. Ophth. 60:826-827, Nov., 1958.

The author suggests the use of a paddle or stick containing two small test objects of the same size. The observer is asked to indicate when he sees both objects and if they are of equal intensity. An abnormal field may bring about a delay in the ability of the patient to recognize the objects simultaneously or similarly. (3 figures, 3 references)

G. S. Tyner.

6

OCULAR MOTILITY

Blatt, N. and Regenbogen, L. **Diagnosis and therapy of parietic vertical tropias in the child by orthoptic and surgical means.** Arch. d'opht. 18:817-832, Dec., 1958.

The authors note that vertical forms of strabismus, once neglected, are now receiving full consideration. They divide vertical errors into the following types: 1. concomitant vertical deviation derived from a pure hyperphoria—a rare entity; 2. spastic vertical deviation, due to overaction of one or both inferior oblique muscles; 3. dissociated vertical deviation, as in alternating hypertropia; 4. vertical deviation due to supranuclear paralyses; and 5. vertical deviation due to nuclear and peripheral paralyses. The authors describe their method of analysis of vertical deviations and present illustrative cases with photographic and diplopiachart documentation. They stress the value of orthoptics used in conjunction with surgery. (11 figures)

P. Thygeson.

Papst, W., Mertens, H.-G. and Esslen, E. **Chronic ocular myositis.** *Klin. Monatsbl. f. Augenh.* 134:374-396, 1959.

This is the second report on this entity. In the first paper chronic ocular myositis within the syndrome of orbital pseudotumor was described (*Klin. Monatsbl. f. Augenh.* 133:673). In this presentation cases of myositis without exophthalmos are discussed. These patients show a severe, often bilateral ophthalmoplegia (pseudomyasthenia). The conjunctiva is occasionally injected, there is a mild leukocytosis and the ESR is increased. Ten such cases were observed.

Electromyography proved to be of great diagnostic value. Invariably a myopathic pattern was obtained. In two instances a biopsy revealed a focal, interstitial myositis. Steroid treatment was usually successful. (14 figures, 2 tables, 42 references) Frederick C. Blodi.

Starkiewicz, Witold. **Treatment of squint by localization method.** *Klinika Oczna* 28:333-345, 1958.

The author claims that normal vision

develops on the basis of optomotor reflexes which start to develop in infancy. Treatment of squints first aims to restore normal uniocular optomotor reflexes. Simultaneous use of both eyes is allowed only when symmetrical points of the retina are stimulated. Eyes are patched alternately and at later stages exercises with instruments are used and prismatic glasses are worn. Games and other exercises to improve optomotor reflexes are used extensively. Surgery is used where it is necessary to place the eyes in normal position. Treatment lasts from a few weeks to a few months. To determine the degree of improvement the author describes a few tests. In cases with abnormal correspondence prisms are used to bring about stimulation of the fovea. Various exercises are used to promote normal fixation and eventually binocular vision. The author claims cure in 75 percent of squints with normal correspondence. Treatment of 10 children (ages 8 to 13 years) with abnormal correspondence, lasted from one to three months and resulted in binocular vision, though in each case the amblyopic eye remained unimproved. (9 figures) Sylvan Brandon.

7

CONJUNCTIVA, CORNEA, SCLERA

Arkin, Wiktor. **Late forms of corneal transplant disease.** *Kinika Oczna* 28:251-257, 1958.

The author calls clouding of the transplanted segment of cornea transplant disease. Early clouding appears within the first few days after the operation and late clouding starts after three weeks. Possible etiologic factors are listed. If the transplant remains transparent for six weeks it may be expected to stay clear. Treatment with steroids may retard the clouding. Occasionally the transplant may be affected by the original disease, like herpes, acne or syphilis. The author

describes a patient in whom a familial degeneration of Groenouw spread into the periphery of the transplant.

Sylvan Brandon.

Heinmueller, G. **Acute keratoconus.** Klin. Monatsbl. f. Augenh. 134:410-413, 1959.

A 19-year-old girl had bilateral acute keratoconus. With cortisone the condition improved within a few weeks and only a thin scar remained. (2 figures, 21 references)

Frederick C. Blodi.

Hoffmann, D. H. and Schirren, C. **Corneal changes in ectodermal dysplasia.** Klin. Monatsbl. f. Augenh. 134:413-416, 1959.

Ectodermal dysplasia comprises a group of congenital anomalies which affect only organs of ectodermal origin. The main signs are hypohidrosis, hypodontia and hypotrichosis. The upper segment of both corneas in a 17-year-old boy with this condition was thin and showed a fine, superficial opacity. (3 figures, 14 references)

Frederick C. Blodi.

Leibold, James E. **Herpes simplex keratitis following febrile illnesses.** U. S. Armed Forces M. J. 10:570-573, May, 1959.

Injection, reduction of vision, pain and photophobia of an eye should make one suspicious of herpes keratitis in patients with febrile illnesses. Contrast between sequelae of three cases in which diagnosis and treatment were delayed and in two cases where early therapy was instituted, is demonstrated. (4 references)

Author's summary.

Strömberg, H. E. and Dohlman, C.-H. **Storage of corneas in the frozen state for keratoplasty.** Acta Ophth. 37:112-118, 1959.

Pretreatment of bovine corneas with

10 percent glycerol at about pH 8.8 (80 ml. of concentrated Krebs-Ringer Solution, 80 ml. of isotonic buffer and 40 ml. of a glycerol-water mixture) for 12 hours gave optimal protection of stroma cells during freezing and thawing. The metabolism remained 60 percent of normal after 24 hours of freezing. (3 figures, 13 references)

John J. Stern.

8

UVEA, SYMPATHETIC DISEASE, AQUEOUS

Gregersen, E. **Postiridic and postglaucomatous iridic atrophy leading to bilateral microcoria, corectopia and false polycoria.** Acta Ophth. 37:143-147, 1959.

Iridic atrophy, microcoria, corectopia and polycoria had developed in a 70-year-old man during the ten years after two attacks of iritis with subsequent increased tension. Histologic examination showed extensive fibrosis and atrophy with severely hyalinized, obliterated iris vessels. The sphincter muscle was well preserved but the dilator fibers were absent. (1 figure, 10 references)

John J. Stern.

Gregory, Irene D. R. **An unusual case of the Vogt-Koyanagi syndrome.** Brit. J. Ophth. 43:113-115, Feb., 1959.

A case of Vogt-Koyanagi syndrome in which the initial lesion was papilledema is presented. Marked posterior uveitis, poliosis, alopecia, and dysacusia were part of the syndrome. Iris tissue culture failed to reveal a virus.

Irwin E. Gaynon.

Hallett, J. W., Wolkowicz, M. I., Feria, Q. A., Leopold, I. H. and Wijewski, E. **Streptococcal serology in uveitis.** A.M.A. Arch. Ophth. 61:79-83, Jan., 1959.

Antistreptolysin "O" serum levels have no significance in uveitis. Antistreptohy-

aluronidase is not found in the aqueous of eyes with uveitis. Serial titration reveals no significant change in titer as the disease passes from an acute into a quiescent stage. (6 tables, 11 references)

Irwin E. Gaynon.

Heydenreich, A. and Schnabel, R. **Clinical and pathologic features of rubeosis of the iris.** Klin. Monatsbl. f. Augenh. 134:350-363, 1959.

Seven diabetic patients were observed. This condition occurs only with diabetes and consists of a new-formation and dilation of radial vessels in the pupillary part of the iris. The ciliary part of the iris remains relatively free from vascular changes. This condition should not be confused with the diffuse and irregular neovascularization in the iris in cases of glaucoma secondary to occlusion of the central vein. This characteristic rubeosis may precede a glaucomatous attack. Peripheral anterior synechiae are usually found in gonioscopic examination. New-formed blood vessels are usually seen in the chamber angle and such vessels rarely occur after central vein occlusion; these eyes always have a diabetic retinopathy. Cyclodiathermy gave the best therapeutic results.

One eye could be examined histologically. There was a proliferation of connective and vascular tissue over the surface of the iris, especially in the pupillary part. All intraocular vessels except those of the iris showed severe sclerosis. (8 figures, 50 references)

Frederick C. Blodi.

Kwaskowski, Adam. **Unusual tumor of the iris.** Klinika Oczna 28:293-298, 1958.

The author presents a case of a tumor of the lower part of the iris in a young woman, 22 years of age. The tumor was totally excised with adjacent iris. Microscopic examination revealed a melanoma

but the patient failed to report for rechecks. (4 figures, 9 references)

Sylvan Brandon.

Lenoch, F., Kralik, V. and Bartos, J. **"Rheumatic" iritis and iridocyclitis.** Ann. Rheumat. Dis. 18:45-48, March, 1959.

Iritis and iridocyclitis do not appear more frequently in patients suffering from rheumatic fever or rheumatoid arthritis than in patients with other diseases or in persons in good health.

Patients with degenerative joint disease of the extremities or of the spine manifest iritis and iridocyclitis only with extreme rarity. Iritis and iridocyclitis frequently accompany ankylosing spondylitis. Different authors have estimated the frequency of these ocular complications at from 10 to 60 percent, but their findings have not been checked against a sufficiently large series of cases.

The authors have carefully re-examined 625 subjects with ankylosing spondylitis and have ascertained that 179 (28.9 percent) had undoubtedly suffered from uveal lesions. This included 163 of 570 males (28.6 percent) and 16 of 55 females (29.1 percent). The authors have also examined 474 adult patients with iritis or iridocyclitis of unknown etiology. Among 269 males 83 cases of unsuspected ankylosing spondylitis were found (30.8 percent) and among 205 females only eight such cases (3.9 percent).

The conclusion is drawn that every case of iritis and iridocyclitis of unknown origin should be examined for latent or incipient ankylosing spondylitis. When such attacks of iritis occur they can be treated with local cortisone ointment. (2 tables, 6 references)

Authors' summary.

Radnót, M. and Kuhár, G. **The operation of iris cysts.** Klin. Monatsbl. f. Augenh. 134:313-316, 1959.

A three year-old boy developed an epithelial cyst of the iris after the removal of an intraocular foreign body. The cornea was opened with a trephine which straddled the limbus and gave easy access to the chamber. The cyst and adherent iris could be excised in toto. (5 figures, 1 table, 4 references)

Frederick C. Blodi.

Vidal, S. **Congenital hyperplasia of the anterior layer of the iris.** Arch. chil. de oftal. 15:63-65, Jan.-June, 1958.

The author emphasizes the difficulty in making a differential diagnosis between the true hyperplasia of the mesodermic layer of the iris and a persistence of the pupillary membrane. He describes the clinical findings in an infant with hyperplasia of the mesodermal layer of the iris in both eyes, with complete occlusion of the right pupillary opening and a somewhat eccentric and small opening in the left eye through the abnormal membrane. (1 figure, 5 references) Walter Mayer.

9

GLAUCOMA AND OCULAR TENSION

Cramer, F. K. and Lamela, N. A. **The influence of the diencephalon on the intraocular pressure.** Arch. oftal. Buenos Aires 33:157-162, July, 1958.

In order to demonstrate whether the diencephalon really contains—as has been postulated—a center which exercises a regulating control of the intraocular pressure, reserpine (a hypotensive principle from *Ophioxylon*, or *Rauwolfia serpentina*) was given orally to 25 patients in daily doses of 30 mg. Of these, 23 were normal, one presented an exfoliation of the lens capsule and one had previously been operated upon for chronic simple glaucoma. The ocular tension was recorded and tonographic studies were made prior to and after the administration of the drug. As a result of the latter,

a slight drop in tension was usually found; since, on the other hand, the facility of outflow remained undisturbed, a diminished rate of flow seemed to be the consequence of the depressing or inhibitory action of the drug on the hypothalamic nuclei. (1 table, 17 references)

A. Urrets-Zavalía, Jr.

Kornblueth, W., Aladjemoff, L., Magora, M. and Gabbay, A. **Influence of general anesthesia on intraocular pressure in man. The effect of diethyl ether, cyclopropane, vinyl ether, and thiopental sodium.** A.M.A. Arch. Ophth. 61:84-87, Jan., 1959.

General anesthesia lowers the intraocular pressure by increasing the coefficient of facility of outflow and relaxing the extraocular muscle. The hypothalamus has a center for the control of intraocular pressure. The results were better than when using curare intravenously. (1 figure, 1 table, 17 references)

Irwin E. Gaynon.

Lee, Pei-Fei. **The influence of epinephrine and phenylephrine on intraocular pressure.** A.M.A. Arch. Ophth. 60:863-867, Nov., 1958.

The author reports some cases of open-angle glaucoma in which a rise in ocular tension occurred after the use of phenylephrine or epinephrine. This rise comes despite the absence of angle blockage by the iris. (3 tables, 13 references)

G. S. Tyner.

Sobanski, J. and Zeydler, L. **Influence of physiologic sleep on intraocular pressure in latent glaucoma.** Klinika Oczna 28:323-331, 1958.

The low ocular tension despite decreased outflow of the aqueous is the result of decreased production of aqueous. The author shows this to be true by blocking the outflow channels with circular perilimbal compression and noting

the lack of increase of intraocular pressure. Low production of aqueous may follow damage to the ciliary body or may be caused by the inhibitory action of the cortex. The increase of intraocular pressure may be demonstrated immediately after awakening. Four patients are described in whom elevated pressure was demonstrated only after deep sleep, and where loss in visual field demonstrated damage to the nerve elements. (4 figures, 4 references) Sylvan Brandon.

10

CRYSTALLINE LENS

Chandler, Paul A. **Problems in the diagnosis and treatment of lens-induced uveitis and glaucoma.** A.M.A. Arch. Ophth. 60:828-841, Nov., 1958.

The author reviews the literature on lens-induced uveitis and glaucoma. He emphasizes the necessity for removal of the offending lens or lens material in the inflamed eye. He also illustrates with a case history that the fellow eye of one subjected to extracapsular lens extraction may develop the syndrome while the eye which has been operated upon remains quiet. (20 references) G. S. Tyner.

François, Jules. **A new syndrome. Dyscephalia with birdface and dental anomalies, nanism, hypotrichosis, cutaneous atrophy, microphthalmia, and congenital cataract.** A.M.A. Arch. Ophth. 60:842-862, Nov., 1958.

The author collected reports of 21 cases from the literature and adds one of his own which seem to illustrate a similar disease complex. He believes that this complex is a hitherto unrecognized syndrome. There are seven salient features: 1. dyscephalia and "bird face," 2. dental anomalies, 3. proportionate nanism (arrest in growth), 4. hypotrichosis (mainly alopecia areata), 5. atrophy of the skin, 6. bilateral microphthalmia, and 7. bilat-

eral congenital cataract. The syndrome develops from an intrauterine disturbance during the fifth or sixth week. The results of cataract surgery are not encouraging. (27 figures, 3 tables, 34 references) G. S. Tyner.

Lerman, Sidney. **The lens in congenital galactosemia.** A.M.A. Arch. Ophth. 61:88-92, Jan., 1959.

The enzyme galactose-1 phosphate uridyl transferase is absent in the lens in congenital galactosemia. The oxidative metabolism of the lens epithelium is impaired. (2 tables, 28 references)

Irwin E. Gaynon.

Regan, Ellen F. **Epithelial invasion of the anterior chamber.** A.M.A. Arch. Ophth. 60:907-927, Nov., 1958.

From this study the author is able to make some helpful clinical suggestions. In order for lens epithelium to grow in the anterior chamber, it must be in contact with iris stroma. This bears out the premise made by Maumenee and Shannon that in the surgical treatment of cataract an iridectomy is essential. The author suggests a limbus-based flap as a preventive measure in cataract surgery. Corneoscleral sutures should be rather superficially placed; and there is possibly less chance of epithelial invasion with mild chromic sutures than with silk. (9 figures, 1 table, 54 references)

G. S. Tyner.

11

RETINA AND VITREOUS

Amsler, M. **Prophylaxis of retinal detachment (amotio retinae).** Schweiz. med. Wchnschr. 89:457-459, April 25, 1959.

Idiopathic primary detachment of the retina is not a disease of itself, it is essentially an episode in a chronic pathological history. It arises in an area of degenerated retina where a tear has occurred. One has to bear in mind the pathologic

sequence of degeneration—tear—detachment both in prophylaxis and treatment.

If a tear has occurred, still without detachment, the eye must be immobilized and the tear has to be closed as soon as possible: the detachment being thereby prevented. More frequently degenerated foci, still without tear, are found, very often also in the second eye. Today it is possible to provide active prophylaxis by means of the light-coagulation of Meyer-Schwickerath. Passive prophylaxis must of course be practiced by avoiding rapid movements and energetic sports. (2 figures, 2 references) Author's summary.

Appelmans, E., von Hoonacker, E. and Daels, H. **Visual and vital prognosis of retinopathy in the course of pancreatic diabetes**, Arch. d'opht. 18:721-733, Oct.-Nov., 1958.

The authors discuss the essential features of retinopathy as a part of diabetes. They conclude 1. that observation and control of the blood sugar gives no warning of the onset of diabetic retinopathy nor of its tendency to progress; and 2. that insulin has ameliorated the prognosis for vision and for life but has not prevented vascular accidents that menace vision and life. In a study of case histories of diabetic retinopathy at onset, they find 1. good vision to be maintained an average of four years; 2. visual progress to show no sex differences; 3. vision to drop more rapidly in older patients; and 4. the percentage of blindness in diabetics as a whole to be 1.45 percent while in those with retinopathy it was 4.56 percent. In the same study they found the survival rate after onset of retinopathy to be an average of 52 months and death to result generally from apoplexy. (10 tables, 22 references)

P. Thygeson.

Fischer, C. Miller. **Observations of the fundus oculi in transient monocular blindness**. Neurology 9:333-347, May, 1959.

Some of the more important features are summarized with comments on their possible significance. The demonstration that transient blindness can exist in a sector of retina, most of whose vessels appear normally filled, affords an explanation for the puzzling cases, usually not reported in the literature, in which an eye was examined during transient, unilateral amaurosis and no abnormality found. This finding might be expected if an embolic particle was invisible or if the arterial obstruction lay proximal to the nerve head. In such cases, light digital pressure on the globe might unmask a failing circulation. Apparently, merely slowing the blood flow without total arrest will produce symptomatic retinal ischemia. In this instance any flow must have come by anastomotic channels unless blood was still penetrating the central part of the white plug. In both observations A and B, the blood column was fragmented in the veins when it was uninterrupted in the arteries, an indication that "cattle trucking" may for some reason be more readily produced in venous blood. Therefore, careful assessment of the circulation in the veins is especially important in these cases. (3 figures, 34 references) From author's summary.

Oksala, Arvo. **The echogram in retinoblastoma**. Acta Ophth. 37:132-137, 1959.

The echogram was studied in two cases of retinoblastoma. In one of them, where vitreous opacities prevented a clear view of the fundus, the diagnosis was mainly based on the echogram. Although the tumor measured only 6 × 6 mm. it could be easily localized. (2 figures, 6 references)

John J. Stern.

Pischel, Dohrmann K. **Slitlamp examination of the fundus**. A.M.A. Arch. Ophth. 60:811-814, Nov., 1958.

The author outlines the principal methods and uses of slitlamp microscopy of

the fundus. The angle between the slit-lamp beam and the line of sight of the microscope must be reduced to 17° . The refractive power of the eye must then be abolished by a contact lens or a preset lens (Hruby).

The uses of the technique in everyday practice may be listed as follows: 1. detection of early papilledema and minute

changes in the macula, 2. differentiation of larger macular cysts from holes, 3. determination of the exact position of hemorrhages, exudates and scars in the vitreous, preretinal area, and retina, and 4. the differential diagnosis of a simple retinal detachment from a detachment caused by a small choroidal tumor or a malignant melanoma.

G. S. Tyner.

NEWS ITEMS

EDITED BY DONALD J. LYLE, M.D.

411 Oak Street, Cincinnati 19, Ohio

News items should reach the editor by the 10th of the month. For adequate publicity, notice of postgraduate courses and meetings should be received three months in advance.

ANNOUNCEMENTS

FIGHT-FOR-SIGHT APPLICATION DATE CHANGED

The National Council to Combat Blindness, Inc. announces that upon the recommendation of its Scientific Advisory Committee, the closing date for receipt of completed applications for Fight for Sight full-time research fellowships, grants-in-aid, and summer student fellowships, has been designated as January 1, 1960. This change of date was found necessary in order to facilitate the processing of the increased number of applications being filed with the organization for review by the committee. It will, in addition, make possible notification in early spring, to those applicants for full-time research fellowships where it has been established that this is essential. In such instances, the commencement date of the fellowship may be in advance of August 1st, but not prior to May 1st.

In general, notification to applicants for full-time research fellowships and grants-in-aid, will go forward in mid-July and the commencement date for awards will continue to be August 1st. Applicants for student fellowships will continue to be notified in mid-May of the action taken by the Scientific Advisory Committee in order that they may make arrangements with their respective institutions to commence work in early summer.

Appropriate forms may be obtained by addressing Secretary, National Council to Combat Blindness, Inc., 41 West 57th Street, New York 19, New York.

The National Council to Combat Blindness, Inc., was founded in 1946 with the primary purpose of financing research in ophthalmology and related sciences. The objective of its program is the ultimate reduction of blinding eye diseases and ocular disorders, through increased basic and clinical research in this field of scientific investigation.

From 1950-1958, the council has allocated almost three quarters of a million dollars for this purpose. Grants and fellowships approved at the May 31, 1959, meeting of the organization's Scientific Advisory Committee, will be announced as soon as all official acceptances have been received.

YALE POSTGRADUATE PROGRAM

Yale University School of Medicine announces the following program in ophthalmology for 1959-60:

September 25th, Dr. Graham Clark, "Personal experiences with the light coagulator"; October 9th, Dr. Richard C. Troutman, "A review of experimental and clinical data concerning alpha-chymotrypsin"; October 23rd, Dr. George D. Pappas, "Electron microscopy of the ciliary body

and its relation to aqueous secretion"; November 6th, Dr. William Stone, Jr., "Secondary postnucleation implants and auxiliary procedures"; November 20th, Dr. Dan M. Gordon, "Treatment of uveitis"; December 4th, Dr. Fred Williams, "Interesting case in eye pathology"; January 29, 1960, Dr. Norah duV Tapley, "The treatment of retinoblastoma by X-rays alone and by the combination of X-rays and T.E.M."; February 26th, Dr. Carlton C. Phillips, "Subnormal visual aids"; March 11th, Dr. H. Saul Sugar, "Secondary glaucoma"; March 25th, Dr. Harvey E. Thorpe, "The management of intraocular foreign bodies."

Each of these meetings will be held in the Beaumont Room, Sterling Hall of Medicine, 333 Cedar Street, New Haven, Conn., on a Friday at 3:45 P.M.

ATLANTIC CITY CLINICAL CONGRESS

Ophthalmic surgery sessions for the clinical congress of the American College of Surgeons to be held in Atlantic City are:

Wednesday, September 30th, 1:30 to 4:00 P.M.: joint session with the Pennsylvania Academy of Ophthalmology and Otolaryngology and the American College of Surgeons, co-chairmen: Murray F. McCaslin, Pittsburgh, and Harold G. Scheie, Philadelphia.

A symposium on "Management of glaucoma," on Wednesday afternoon, with Harold G. Scheie, as moderator will include: "Present status of Diamox in the treatment of glaucoma," Goodwin M. Breinin, New York; "Value of tonography in glaucoma," George S. Tyner, M.D., Denver; "Surgical treatment of glaucoma," Joseph S. Haas, Chicago; "Present-day approaches of research in glaucoma," Frank W. Newell, Chicago. An open discussion will follow.

On Thursday afternoon, October 1st, the joint session of the New Jersey Academy of Ophthalmology and Otolaryngology, Ophthalmology Section, and the American College of Surgeons will convene at 1:30 with Louis A. Amdur, Jersey City, and William B. Clark, New Orleans, as co-chairman. The program will be a symposium on "Recent advances in ophthalmic surgery." Dr. Clark will be moderator. The speakers will include: "Recent advances in cataract extraction," John M. McLean, New York; "Evaluation of current techniques in retinal detachment surgery," A. D. Ruedemann, Detroit; "Current concepts in the management of malignancies of the eye, orbit and adnexa," Algeron B. Reese, New York; "Present status of keratoplasty," R. Townley Paton, New York.

SOCIETIES

WEST VIRGINIA

The West Virginia Academy of Ophthalmology and Otolaryngology at the spring meeting elected the following officers for the coming year: President, Nime K. Joseph, Wheeling; president-elect, John A. B. Holt, Charleston; vice president, William K. Marple, Huntington; secretary-treasurer, Albert C. Esposito, Huntington; director for two years, James T. Spencer, Charleston. The next meeting will be August 20 to 23, 1959, at the Greenbrier Hotel, White Sulphur Springs.

FRENCH MEETING

The program for the recent meeting of the French Society of Ophthalmology included:

Mawas, "Innervation of the ciliary body in man"; Brini and Porte, "Study of the ciliary body with electronic microscope"; Trantas, "Some cases of atrophy of the sclerocorneal trabecula"; Amalric, Bessou and Lescure, "Relationship between congenital heterochromia, the syndrome of Claude Bernard and the syndrome of Fuchs"; Rocha, "Can sympathetic ophthalmia occur without perforation?"; Zenatti, "Contribution of tonography in the diagnosis of chronic glaucoma"; Offret, Haye and Campinchi, "Histologic examination of an eyeball operated upon for cataract with enzymatic zonulolysis"; Busacca, "The anatomic and embryologic basis for the mechanism of zonulolysis and the appearance of hernias of the vitreous body in the anterior chamber"; Renard and Dhermy, "Consideration on the intraocular penetration of an epithelioma arising from the sinus extending into the orbit"; Bengisu and Sezer, "Isolation of the virus of Bechet's disease in hypopyon"; Bouzas, "Neurologic manifestations of Bechet's disease"; Laine and François, "Aneurysms of the internal border of the internal carotid"; Wertheimer, Rougier, Wertheimer and Lapras, "The value of Parinaud's syndrome in cerebral neoplasms"; Viallefond, Boudet and Paleirac, "The radiologic examination of the cavernous sinus"; Melanowski, "Simple orbitotomy in cases of intraorbital tumors of the optic nerve"; Mergier, "A case of benign retrobulbar tumor"; Straub, "Changes in the human eye by hydroquinone."

Winkelman and Horsten, "Electroretinogram in the newborn"; Druault-Toufesco, "Influence of weight and hygiene in general on diabetic retinopathy and the prediabetic status"; Calmettes, Deodati, Bec and Bechac, "In regards to seven observations of dysoric retinal nodules"; Remky, "Uveitis due to acquired toxoplasmosis, neurologic and clinical aspect"; Perdriel and Raynaud, "Corneal lenses and altitude"; François, "The report on congenital cataract"; Velissaropoulos and Topalis, "The use of alpha chymotrypsin in operation for congenital cataract"; Avanza and Balaivoine, "A new type of cataract (umbilicated cataract) associated with brachymorphia and an external ophthalmoplegia"; Franceschetti and Dieterle, "The 'pagoda' congenital cataract and its relations with central dotlike cataract"; Delthil and Crouzet, "Cataracts and congenital malformations in the pupils

of classes of amblyopic patients in Paris"; Petit-Dutaillis, Guillaumat and Wiart, "Hypophyseal adenomas with typical symptoms, prognostic value"; Bregeat, Juge and Chaire, "Anomalies of the field of vision in ocular motor paralysis which persists"; Thiebaut and Matavuli, "Contributions to the study of visual fields in the lesions of the temporal lobe"; Dollfus, Guillaume and Lebouc, "Appearance of the disc and the retina in the course of the ocular examination of 478 cases of brain injury"; Massin, "What should one do in the presence of a lesion of the optic nerve consecutive to a cranio-orbital concussion"; Desvignes, Bessmann and Lormeau, "On sensorial ocular disturbances appearing late after a cranial injury"; Ricci and Maeder, "Two cases of functional blindness with progressive recovery."

Saraux and Martin, "Tonic pupil and the syndrome of Adie"; Ardouin, Carrot, Feuvrier, and Catros, "Retinopathy of multiple sclerosis"; Zanen, "The photochromatic interval in neuro-ophthalmology"; Collier, "Late epilepsy and the syndrome of hemihypertrophy, follicular keratosis of Darier, nevus and myelinated fibers in the retina"; Postic, "Comparative studies of the origin of chronic follicular conjunctivitis"; Vassilev, "Surgical treatment of parenchymatous xerosis; (method of Filatov-Schewaljaw)" ; Rosselet, Stucchi and Dufour, "The role of tuberculosis in the uveitis of infancy"; Larmande and Orfila, "Comparative morphology of the bacillus of Weeks and Pfeiffer under the electronic microscope"; Litricin and Stankovic, "Contribution to the study of the problem of primary malignant tumor of the cornea"; Sedan, Miller, Guillot, and Farnarier, "On the importance of a professional orientation preliminary to the study of ophthalmology"; Valk, "Favorable influence of nor-androste-nolon-phenyl-propionate on diabetic retinopathy"; Zuccoli, "New operative technique for the prophylactic treatment of diabetic retinopathy alterations of Rickettsia origin"; Retinal vascular alterations of Rickettsia origin"; Hervouet, "Anomalies revealed in eyes that have idiopathic retinopathy"; Woillez, Asseman and Lekieffre, "Unusual complications of temporal arteritis"; Baron Le Bourhis-Gouray, "The action of the corticosteroids on herpetic lesions of the eye."

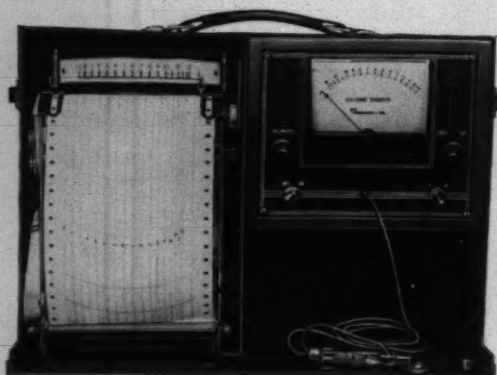
PERSONALS

Dr. F. Herbert Haessler, Marquette University School of Medicine's first full-time professor in the clinical departments, retired July 1, 1959. Dr. Haessler has been professor and chairman of the Department of Ophthalmology since January 15, 1949, when an anonymous benefactor established the first full-time chair of ophthalmology. Dr. Haessler devoted his time to the management of the eye clinic and dispensary in the medical school, to teaching medical students, and to the development of a training program for physicians interested in a career in ophthalmology.

Though Dr. Haessler will retire from his duties at Marquette, he will continue as abstract editor of THE AMERICAN JOURNAL OF OPHTHALMOLOGY.

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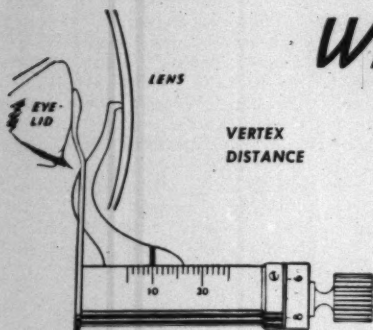
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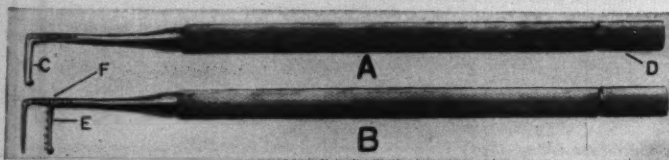
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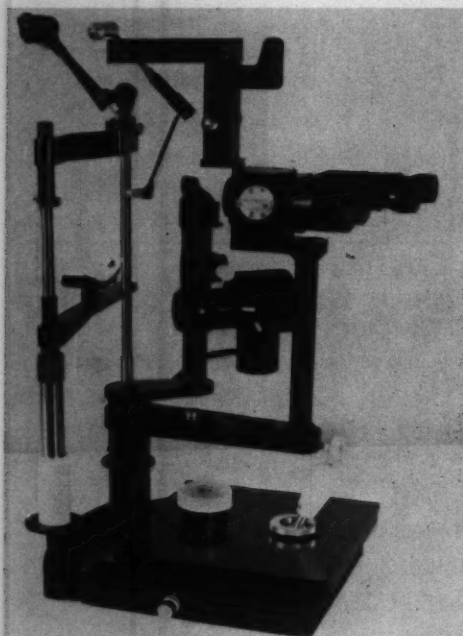
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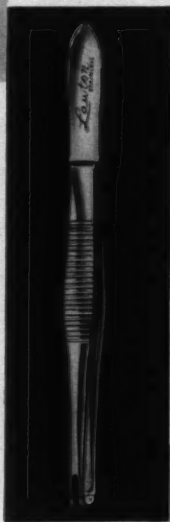
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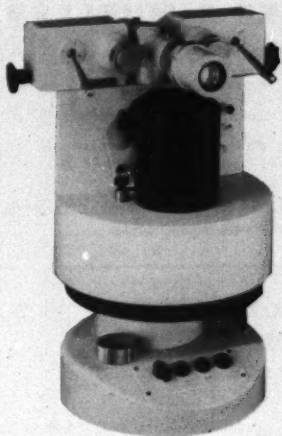
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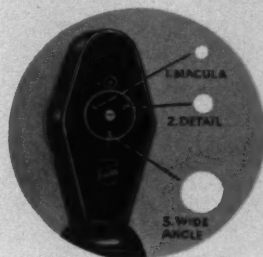
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1380G
OPHTHALMOSCOPE



APERTURE CONTROL

CORD HANDLE

1387G

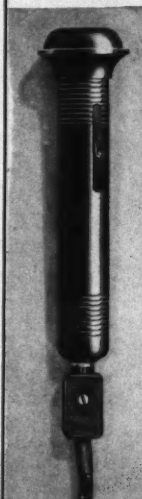
Fits any Keeler Head
e.g. Ophthalmoscope,

Retinoscope

Keratoscope

Built-in Rheostat

Easily connected to
any 3 v. supply.



STREAK AND DYNAMIC RETINOSCOPES

Novel design and placing of controls on *Streak Retinoscope 1394G* makes refraction easier, speedier. The streak may be rotated continuously to facilitate axis determination near the horizontal. Brilliant reflex.

Dynamic Retinoscope 1392G. Accurately scaled-down Snellen Chart for refraction at near to determine reading add. Sliding shield obscures Chart for distance refraction.



KEELER OPTICAL PRODUCTS, INC.

5241 Whitby Avenue, Philadelphia 43, Pa.
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Announcing

a new
Solution for
an
old ocular
problem

Prednefrin® **S**

OPHTHALMIC SOLUTION

Prednefrin **S** means new relief in sight—for patients with inflammatory and allergic disorders of the anterior segment. Prednefrin **S** provides potent anti-inflammatory action (0.2% prednisolone) plus the advantages of immediate and prolonged decongestant effect . . . in a lubricating, non-irritating, special solution—a solution which assures uniform concentrations, freedom from stinging or burning on instillation and freedom from irritation for as long as therapy continues. *Taken together*, the ingredients in Prednefrin **S** *work together* to safeguard sight—at the site.

The complete Prednefrin **S** formula: prednisolone alcohol 0.2%, and phenylephrine HCl 0.12% in a sterile, lubricating solution—for

prompt control of inflammatory and allergic conditions of the eyelids, conjunctiva, cornea, sclera, uveal tract and following thermal or chemical burns.

DOSAGE: 1 to 2 drops two to four times daily. In initial 24-48 hours, the dosage may be increased safely to 2 drops every hour.

SUPPLY: In 5 cc. plastic dropper bottles—on prescription only.

Also Available . . . Prednefrin® Ophthalmic Suspension—whenever the repository effect of a “solution-like” suspension and less potent anti-inflammatory action are indicated in the inflammatory conditions.

ALLERGAN CORPORATION

 Los Angeles 17, California